OCT 16 1990

FLOOD INSURANCE STUDY

HARRIS COUNTY, TEXAS AND INCORPORATED AREAS

VOLUME 1 OF 8

COMMUNITY NAME	COMMUNITY NUMBER
BELLAIRE, CITY OF	480289
DEER PARK, CITY OF	480291
EL LAGO, CITY OF	485466
GALENA PARK, CITY OF	480293
HOUSTON, CITY OF	480296
HUMBLE, CITY OF	480297
HUNTERS CREEK VILLAGE, CITY OF	480298
JACINTO CITY, CITY OF	480299
JERSEY VILLAGE, CITY OF	480300
LA PORTE, CITY OF	485487
MORGANS POINT, CITY OF	480305
NASSAU BAY, CITY OF	485491
PASADENA, CITY OF	480307
PEARLAND, CITY OF	480077
PINEY POINT VILLAGE, CITY OF	480308
SHOREACRES, CITY OF	485510
SOUTH HOUSTON, CITY OF	480311
SPRING VALLEY, CITY OF	480313
TAYLOR LAKE VILLAGE, CITY OF	485513
TOMBALL, CITY OF	480315
UNINCORPORATED AREAS	480287
WEBSTER, CITY OF	485516

SEPTEMBER 28, 1990

Federal Emergency Management Agency

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide Flood Insurance Study Effective Date: September 28, 1990

Flood Insurance Study Revised:

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Flood Insurance Rate Map

FLOOD INSURANCE STUDY
HARRIS COUNTY AND INCORPORATED AREAS, TEXAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide-format Flood Insurance Study revises and updates previous Flood Insurance Studies/Flood Insurance Rate Maps for the geographic area of Harris County, Texas, including: the unincorporated areas of Harris County, and the Cities of Bellaire, Deer Park, El Lago, Galena Park, Houston, Humble, Hunter's Creek Village, Jacinto City, Jersey Village, La Porte, Missouri City, Morgans Point, Nassau Bay, Pasadena, Pearland (within Harris County), Piney Point Village, Shoreacres, South Houston, Spring Valley, Taylor Lake Village, Tomball, and Webster (hereinafter referred to collectively as Harris County); the City of Houston, which is located in three counties, is shown in its entirety in this countywide Flood Insurance Study. The Chelford City Municipal Utility District, and the Cities of Bunker Hill Village, Hedwig Village, Hilshire Village, Southside Place, and West University Place, which are located in Harris County, are non-flood-prone communities. The Flood Insurance Rate Map (FIRM) and flood profiles for Harris County will also show the portions of the Cities of Baytown, Friendswood, Katy, Missouri City, Seabrook, Stafford, and Waller, and of the Kingsbridge Municipal Utility District that lie within Harris County; these areas are located in two or more counties. These areas have been shown on the Harris County FIRM for informational purposes only; the information contained on the Harris County FIRM for these areas is not to be used for flood insurance purposes. Refer to the separately printed Flood Insurance Studies/Flood Insurance Rate Maps for these areas for flood insurance purposes. This information will be used by Harris County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This revision was prepared to include incorporated communities within Harris County into a countywide Flood Insurance Study. Those incorporated communities were shown as Areas Not Included (ANI) in the Flood Insurance Study and on the FIRM for the unincorporated areas of Harris County, dated February 4, 1988. The flood hazard information previously shown separately on the Flood Boundary Floodway Maps for the unincorporated areas of the county and the former ANI now appears on the FIRM for this countywide Flood Insurance Study. Information on the authority and acknowledgments for each of these Flood Insurance Studies/FIRM (hereinafter referred to as studies), compiled from their effective Flood Insurance Study report narratives, is shown below.

Unincorporated Areas of Harris County: the hydrologic and hydraulic analyses for the study effective December 31, 1983 were prepared by the Galveston District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto; the coastal analyses were prepared by Tetra Tech, Inc., for FEMA, under Contract No. H-4788 and amendments thereto. This work was completed in June 1982. In the revision effective September 27, 1985, portions of the original analyses were updated by the Harris County Flood Control District (HCFCD) to reflect rapid development and improvements made to the watersheds within the county. The work for the revision was completed in November 1984.

City of Bellaire: the hydrologic and hydraulic analyses for the study effective September 30, 1981 were prepared by the Galveston District COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14 and amendments thereto, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. The work for the original study was completed in February 1980. In the revision effective May 4, 1987, updated hydrologic and hydraulic analyses were prepared by the HCFCD to reflect rapid development within the

	watersheds affecting the community. The work for the revision was completed in November 1984.
City of Deer Park	the hydrologic and hydraulic analyses for the study effective August 15, 1980 were prepared by the U. S. Geological Survey (USGS) for FEMA. In the revision effective February 1, 1984, updated hydrologic and hydraulic analyses were prepared by the Galveston District COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1, and amendments thereto. A tidal analysis was prepared as part of the revision by Tetra Tech, Inc. for FEMA, under Contract No. H-4788. The work for the revised study was completed in December 1981.
City of El Lago:	the hydrologic and hydraulic analyses for the study effective December 15, 1983 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1, and amendments thereto. Tidal and wave height analyses were performed as part of the revision by Tetra Tech, Inc. for FEMA, under Contract No. H-4788. The work for the revised study was completed in August 1981.

City of Galena Park:	the hydrologic and hydraulic analyses for the study effective November 2, 1982 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1, and amendments thereto. Tidal and wave height analyses were performed as part of the revision by Tetra Tech, Inc. for FEMA, under Contract No. H-4788. The work for the revised study was completed in August 1981.
City of Houston:	the hydrologic and hydraulic analyses for the revised study effective September 27, 1985 were prepared by the Galveston District COE for FEMA, under Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. Coastal analyses were prepared by Tetra Tech, Inc., for FEMA, under Contract No. H-4788 and amendments thereto. This work was completed in June 1982. In the revision effective September 4, 1987, the HCFCD updated portions of the hydrologic and hydraulic analyses to reflect rapid development and improvements made to the watersheds. This work was completed in January 1984.
City of Humble:	the hydrologic and hydraulic analyses for the study effective September 16, 1982 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. This work was completed in March 1980.
City of Hunter's Creek Village:	the hydrologic and hydraulic analyses for the study effective November 5, 1980 were prepared by the COE for FEMA,

under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1, Amendments 7 and 11. This work was completed in November 1978.

City of Jacinto City: the hydrologic and hydraulic analyses for the study effective September 2, 1981 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. This work was completed in January 1980.

City of Jersey Village: the hydrologic and hydraulic analyses for the study effective March 15, 1982 were prepared by the Galveston District COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. This work was completed in February 1980. In the revision effective April 3, 1985, the HCFCD prepared updated hydrologic and hydraulic analyses under agreement with FEMA. The work for the updated study was completed in July 1983.

City of La Porte: the hydrologic and hydraulic analyses for the study effective September 1, 1985 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. Coastal analyses were prepared by Tetra Tech, Inc., under Contract No. H-4788 and amendments thereto. This work was completed in June 1982. Portions of this work were subsequently updated by the HCFCD to reflect rapid development

and improvements made to the watersheds. This work was completed in September 1983.

City of Morgans Point: the hydrologic and hydraulic analyses for the study effective December 1, 1983 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. Coastal analyses were prepared by Tetra Tech, Inc., under Contract No. H-4788. This work was completed in October 1981.

City of Nassau Bay: the hydrologic and hydraulic analyses for the study effective January 1, 1984 were prepared by the Galveston District COE for FEMA, under Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto, and Project Order 14, Amendment 3. The tidal analysis and wave height analysis were prepared by Tetra Tech, Inc., for FEMA, under Contract No. H-4788. This work was completed in August 1981.

City of Pasadena: the hydrologic and hydraulic analyses for the revised study effective June 3, 1986 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. Coastal analyses were prepared by Tetra Tech, Inc., for FEMA, under Contract No. H-4788 and amendments thereto. This work was completed in June 1982. Portions of the hydrologic and hydraulic analyses were revised by the HCFCD to reflect rapid development and improvements made to the watersheds. This work was completed in September 1983.

City of Pearland: the hydrologic and hydraulic analyses for Clear Creek in the study effective

July 5, 1984 were prepared by Dewberry & Davis. This work was completed in June 1983. The hydrologic and hydraulic analyses for Marys Creek and Marys Creek Bypass Channel were prepared by Woodward-Clyde Consultants for FEMA, under Contract No. H-4787. This work was completed in June 1981.

City of Piney Point Village: the hydrologic and hydraulic analyses for the study effective December 2, 1980 were prepared by the Galveston District COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1, Amendments 10 and 11. This work was completed on November 29, 1978.

City of Shoreacres: the hydrologic and hydraulic analyses for the study effective November 20, 1970 were prepared by the COE for FEMA. The hydrologic and hydraulic analyses for the revised study effective May 15, 1984 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. Tetra Tech, Inc., prepared the tidal and wave height analyses for FEMA, under Contract No. H-4788, and amendments thereto. This work was completed in August 1981.

City of South Houston: the hydrologic and hydraulic analyses for the study effective March 18, 1987 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. This work was completed in August 1981. Portions of the hydrologic and hydraulic analyses were revised by the HCFCD to reflect rapid development and improvements made to the watersheds. This work was completed in June 1985.

City of Spring Valley:	the hydrologic and hydraulic analyses for the study effective June 4, 1980 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1, Amendments 7 and 11. This work was completed in November 1978.
City of Taylor Lake Village:	the hydrologic and hydraulic analyses for the revised study effective February 15, 1984 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. The tidal analysis was prepared by Tetra Tech, Inc., under Contract No. H-4788. This work was completed in August 1981.
City of Tomball:	the hydrologic and hydraulic analyses for the study effective December 18, 1984 were prepared by the Galveston District COE for FEMA, under Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. This work was completed in June 1982. Portions of the analyses were updated by the HCFCD to reflect rapid development and improvements made to the watersheds. This work was completed in September 1983.
City of Webster:	the hydrologic and hydraulic analyses for the revised study effective June 15, 1984 were prepared by the COE for FEMA, under Inter-Agency Agreement No. H-07-76, Project Order No. 14, Amendment 3, and Inter-Agency Agreement No. H-10-77, Project Order No. 1 and amendments thereto. The tidal analyses were prepared by Tetra Tech, Inc., for FEMA, under Contract No. H-4788. This work was completed in August 1981.

The following tabulation shows the flooding sources for which revised hydrologic and/or hydraulic analyses were performed for this revision, the study contractors that carried out the work, and the completion dates of the work.

Flooding Source	Revision Contractor	Completion Date
Brays Bayou	Pate Engineers, Inc.	October 1988
Greens Bayou	Pate Engineers, Inc.	November 1988
Halls Bayou	Dodson & Associates, Inc.	October 1988
Garners Bayou	Dodson & Associates, Inc.	October 1988
Tributary 26.20 to Brays Bayou	Lockwood, Andrews & Newnam, Inc.	October 1988
Spring Branch	HCFCD	September 1988
Turkey Creek (A119-00-00) and Halls Road Ditch	HCFCD	October 1988
Tributary 9.39 to Armand Bayou and Tributary 4.51 to Horsepen Bayou	Turner, Collie & Braden, Inc.	October 1988
Cypress Creek, Dry Creek, Tributary 37.1 to Cypress Creek, Channel A to Cypress Creek, and Channel D to Channel A to Cypress Creek	Turner, Collie & Braden, Inc.	October 1988
Tributary 26.64 to Greens Bayou, P155-00-00, and P156-00-00	Dodson & Associates, Inc.	March 1989
Willow Creek	Harris County Engineering Department (HCED)	November 1988
Cypress Creek	HCED	November 1988
White Oak Bayou	HCED	November 1988
North shore of Burnett Bay	HCED	November 1988
East Fork San Jacinto River	HCFCD	November 1988
Sims Bayou	CRS-Sirrine, Inc.	December 1988
Clodine Ditch and Buffalo Bayou	Van Sickle, Mickelson & Klein, Inc.	July 1988

1.3 Coordination

The dates of the initial and final Consultation and Coordination Officer's (CCO) meetings held for Harris County and the incorporated communities within its boundaries are shown in the following tabulation.

Community Name	Initial CCO Date	Final CCO Date
Unincorporated Areas of Harris County	*	*
City of Bellaire	*	June 18, 1986
City of Bunker Hill Village	May 10-13, 1976	April 23, 1979
City of Deer Park	*	July 8, 1982
City of El Lago	May 10-13, 1976	July 12, 1982
City of Galena Park	May 10-13, 1976	May 25, 1982
City of Houston	*	*
City of Humble	May 10-13, 1976	November 20, 1980
City of Hunter's Creek Village	May 10-13, 1976	June 12, 1979
City of Jacinto City	May 10-13, 1976	September 22, 1976
City of Jersey Village	May 10-13, 1976	November 20, 1980
City of La Porte	May 10-13, 1976	November 14, 1984
City of Morgans Point	May 10-13, 1976	July 8, 1982
City of Nassau Bay	May 10-13, 1976	October 19, 1983
City of Pasadena	May 10-13, 1976	November 13, 1984
City of Pearland	May 1978	October 18, 1982
City of Piney Point Village	May 10-13, 1976	April 24, 1979
City of Shoreacres	May 10-13, 1976	July 9, 1982
City of South Houston	May 10-13, 1976	November 15, 1984
City of Spring Valley	May 10-13, 1976	April 23, 1979
City of Taylor Lake Village	May 10-13, 1976	July 7, 1982
City of Tomball	May 10-13, 1976	June 6, 1984
City of Webster	May 10-13, 1976	October 19, 1982

*Data not available

The initial CCO meetings were held with representatives from FEMA, the communities, and the study contractors to explain the nature and purpose of Flood Insurance Studies, and to identify the streams to be studied by detailed methods. The final CCO meetings were held with representatives from FEMA, the communities, and the study contractors to review the results of the studies. On September 14, 1989, the results of this countywide study were reviewed at a final CCO meeting attended by representatives of the county and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the geographic area of Harris County, Texas. The area of study is shown on the Vicinity Map (Figure 1).

Many of the unnamed tributaries located in Harris County were studied by detailed methods. For the purposes of this Flood Insurance Study, each unnamed tributary was assigned a name based upon the location of its confluence with respect to the receiving body. For example, Tributary 26.20 to Brays Bayou is a tributary of Brays Bayou having its confluence 26.20 miles upstream along Brays Bayou from the confluence of Brays Bayou and its receiving body.

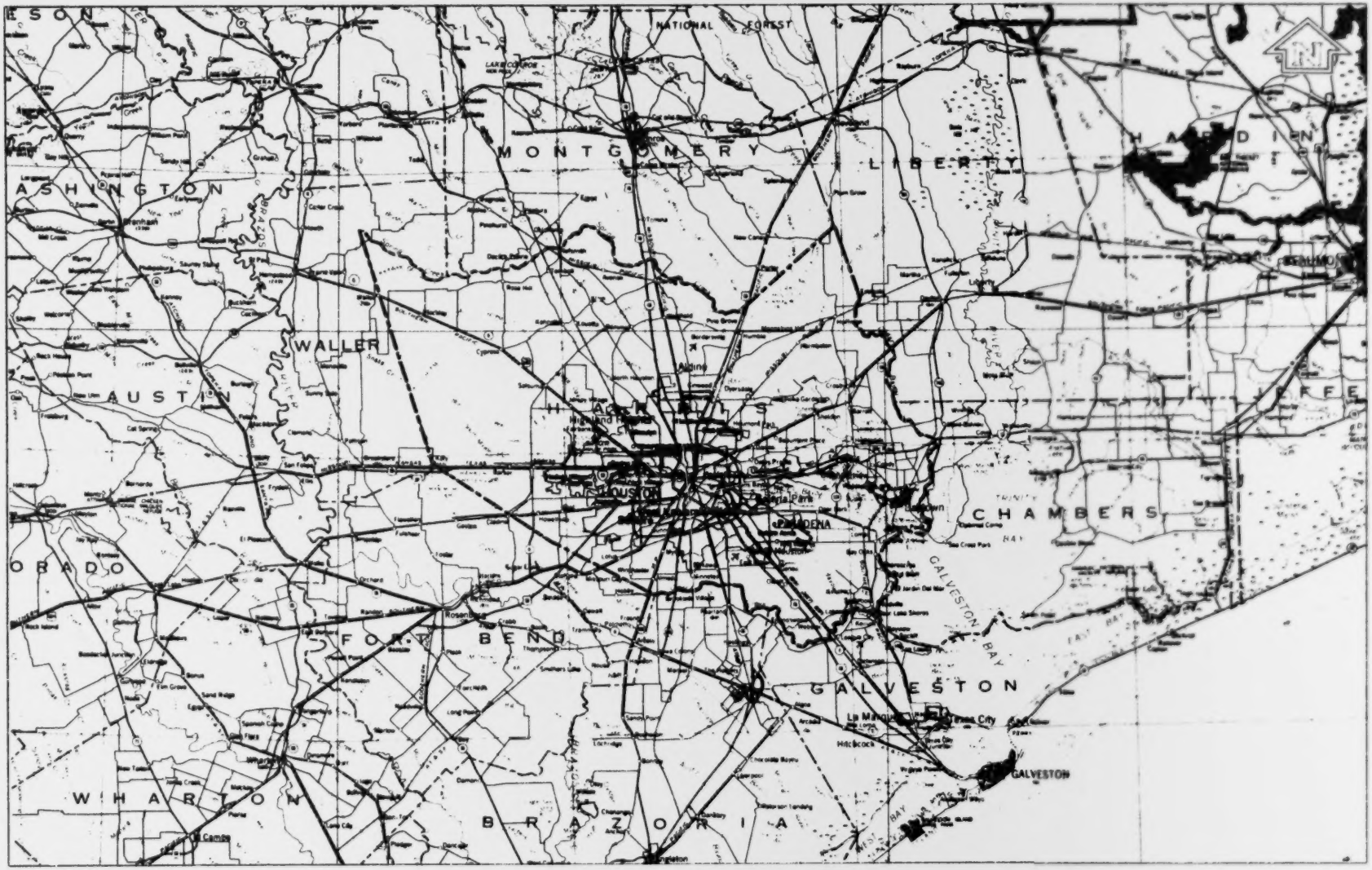


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRIS COUNTY, TX
AND INCORPORATED AREAS

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

The HCFCD maintains a number designation for streams in Harris County; this designation is listed along with each common name or tributary mile number. Under the HCFCD system, each major watershed is assigned a letter designation that is used as a prefix for all number designations in that watershed. The main channel typically starts the system with the number designation 100-00-00 and the tributaries are assigned higher numbers (101-00-00, 102-00-00, etc.) as one progresses upstream along the main channel. Further subdivisions of the watershed are reflected by assigning higher number designations to the tributaries, while maintaining the letter designation prefix of the watershed.

Table 1, "Scope of Study," lists the common stream name and the HCFCD designation (where applicable) for all riverine flooding sources studied by detailed methods. Throughout the remaining portion of this text, HCFCD designation numbers appear only for flooding sources that have the same common stream name, such as Turkey Creek (A119-00-00), Turkey Creek (K111-00-00), and Turkey Creek (W167-00-00). Detailed riverine analyses were terminated when the drainage area upstream was reduced to less than one square mile or when the 100-year floodplain was found to be less than 200 feet wide for its entire length upstream. The flooding sources studied by detailed methods are grouped by watershed, and listed in order from the downstream end to the upstream end of each watershed, along the main flooding source. Limits of detailed study for each flooding source, from downstream to upstream, are listed in stream miles measured from the studied stream's confluence with its receiving water body, or noted landmark.

TABLE 1 - SCOPE OF STUDY

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	STREAM MILE FROM	STREAM MILE TO
		Clear Creek Watershed		
Clear Creek	A100-00-00	Galveston Bay	4.73	47.82
Taylor Bayou	A104-00-00	Clear Creek	1.25	5.10
Tributary 3.10 to Taylor Bayou	A104-04-00	Taylor Bayou	0.00	0.65
Tributary 3.36 to Taylor Bayou	A104-13-00	Taylor Bayou	0.00	1.10
Tributary 3.93	A104-07-00	Taylor Bayou	0.00	1.74
Cow Bayou	A107-00-00	Clear Creek	0.00	2.13
Tributary 10.08 to Clear Creek	A111-00-00	Clear Creek	0.00	3.26
Cedar Gully	A118-00-00	Clear Creek	0.00	0.26
Turkey Creek	A119-00-00	Clear Creek	0.00	4.42
Tributary 0.16 to Turkey Creek	A119-02-00	Turkey Creek	0.00	0.69
Halls Road Ditch	A120-00-00	Clear Creek	0.00	5.51
Armand Bayou	B100-00-00	Clear Creek	0.47	13.62

TABLE 1 - SCOPE OF STUDY - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY (OR LANDMARK)	STREAM MILE FROM	STREAM MILE TO
		Clear Creek Watershed - continued		
Horsepen Bayou	B104-00-00	Armand Bayou	0.00	6.63
Tributary 4.51 to Horsepen Bayou	B104-04-00	Horsepen Bayou	0.00	1.59
Tributary 5.44 to Horsepen Bayou	B104-05-00	Horsepen Bayou	0.15	0.68
Big Island Slough	B106-00-00	Armand Bayou	0.00	6.48
Spring Gully	B109-00-00	Armand Bayou	0.00	1.75
Tributary 9.39 to Armand Bayou	B111-00-00	Armand Bayou	0.00	1.89
Willow Springs Bayou	B112-00-00	Armand Bayou	0.00	4.24
Tributary 1.78 to Willow Springs Bayou	B112-02-00	Willow Springs Bayou	0.00	0.77
Tributary B to Willow Springs Bayou	----------	Willow Springs Bayou	0.00	1.15
Tributary 10.46 to Armand Bayou	B113-00-00	Armand Bayou	0.00	2.13
Tributary 12.18 to Armand Bayou	B115-00-00	Armand Bayou	0.00	1.45
		San Jacinto River Watershed		
San Jacinto River	G103-00-00	Galveston Bay	0.00	28.20
Lake Houston	G103-00-00	San Jacinto River	0.00	9.25
Goose Creek	0100-00-00	San Jacinto River	0.00	11.99
East Fork Goose Creek	0105-00-00	Goose Creek	0.00	2.61
Spring Gully	0200-00-00	San Jacinto River	0.00	3.13
Jackson Bayou	R100-00-00	San Jacinto River	0.00	4.75
Gum Gully	R102-00-00	Jackson Bayou	0.00	7.10
Tributary 2.70 to Gum Gully	R102-03-00	Gum Gully	0.00	1.20
Tributary 3.08 to Gum Gully	R102-13-00	Gum Gully	0.00	1.59
West Fork San Jacinto River	G103-00-00	Lake Houston Dam	9.98	19.55
Bens Branch	G103-33-00	West Fork San Jacinto River	0.00	4.94
Jordan Gully	G103-43-00	West Fork San Jacinto River	0.00	2.13

TABLE 1 - SCOPE OF STUDY - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY (OR LANDMARK)	STREAM MILE FROM	STREAM MILE TO
San Jacinto River Watershed - continued				
Tributary 16.8 to West Fork San Jacinto River	----------	West Fork San Jacinto River	0.00	0.66
Tributary 17.7 to West Fork San Jacinto River	----------	West Fork San Jacinto River	0.00	1.47
East Fork San Jacinto River	G103-80-00	Lake Houston Dam	9.25	19.78
Luce Bayou	S100-00-00	East Fork San Jacinto River	0.00	1.59
Shook Gully	S110-00-00	Luce Bayou	0.00	1.67
Mexican Gully	S114-00-00	Luce Bayou	0.00	0.32
Caney Creek	G103-80-03	East Fork San Jacinto River	0.00	2.20
White Oak Creek	G103-80-03.2	Caney Creek	0.62	1.80
Taylor Gully	G103-80-03.1	Caney Creek	0.00	2.46
Mills Branch	G103-80-03.2A	White Oak Creek	0.00	1.42
Buffalo Bayou Watershed				
Buffalo Bayou	W100-00-00	San Jacinto River	0.00	47.52
Buffalo Bayou Split Flow	----------	Buffalo Bayou	0.00	0.52
Patrick Bayou	G104-00-00	Buffalo Bayou	0.00	3.92
East 13th Street Outfall Channel	----------	Patrick Bayou	0.00	1.15
Glenmore Ditch	G108-00-00	Buffalo Bayou	0.00	2.40
Carpenters Bayou	N100-00-00	Buffalo Bayou	0.00	11.71
Tributary 3.33 to Carpenters Bayou	N104-00-00	Carpenters Bayou	0.00	2.16
Tributary 11.715 to Carpenters Bayou	N117-00-00	Carpenters Bayou	0.00	1.63
Sheldon Reservoir	----------	Carpenters Bayou	*	*
Tributary 6.77 to Buffalo Bayou	----------	Buffalo Bayou	0.00	0.66
Hunting Bayou	H100-00-00	Buffalo Bayou	0.00	14.47
Tributary 5.22 to Hunting Bayou	H103-00-00	Hunting Bayou	0.00	0.95

*Entire area within community

TABLE 1 - SCOPE OF STUDY - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	STREAM MILE FROM	STREAM MILE TO
		Buffalo Bayou Watershed - continued		
Tributary 12.05 to Hunting Bayou	H118-00-00	Hunting Bayou	0.00	1.31
Tributary 12.70 to Hunting Bayou	H110-00-00	Hunting Bayou	0.00	0.80
Tributary 13.85 to Hunting Bayou	H112-00-00	Hunting Bayou	0.00	0.46
Tributary 8.17 to Buffalo Bayou	----------	Buffalo Bayou	0.00	0.97
Vince Bayou	I100-00-00	Buffalo Bayou	0.00	5.94
Little Vince Bayou	I101-00-00	Vince Bayou	0.00	4.09
Panther Creek	G112-00-00	Buffalo Bayou	0.00	0.87
Spring Branch	W140-00-00	Buffalo Bayou	1.10	4.15
Briar Branch	W140-01-00	Spring Branch	0.00	3.21
Bering Ditch	W142-00-00	Buffalo Bayou	0.00	1.25
Rummel Creek	W156-00-00	Buffalo Bayou	0.00	2.78
Turkey Creek	W167-00-00	Buffalo Bayou	0.00	8.58
Tributary 3.9 to Turkey Creek	W167-01-00	Turkey Creek	1.89	3.05
Addicks Reservoir	----------	Langham Creek	*	*
Langham Creek	U100-00-00	Buffalo Bayou	3.39	17.18
Addicks Reservoir Diversion Channel	----------	Langham Creek	0.00	1.45
South Mayde Creek	U101-00-00	Langham Creek	3.79	18.90
Tributary 9.4 to South Mayde Creek	U101-07-01	South Mayde Creek	0.00	4.02
Bear Creek	U102-00-00	Langham Creek	4.34	17.31
Horsepen Creek	U106-00-00	Langham Creek	0.00	6.22
Dinner Creek	U120-00-00	Langham Creek	0.00	3.54
Clodine Ditch	----------	Buffalo Bayou	0.00	5.17
Barker Reservoir	----------	Buffalo Bayou	*	*
Cane Island Branch	T100-00-00	Buffalo Bayou	0.39	5.65
Mason Creek	T101-00-00	Buffalo Bayou	0.00	7.63
Tributary 4.96 to Mason Creek	T101-03-00	Mason Creek	0.00	3.07
Tributary 52.9 to Buffalo Bayou	T103-00-00	Buffalo Bayou	0.00	2.52

*Entire area within community

TABLE 1 - SCOPE OF STUDY - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	STREAM MILE FROM	STREAM MILE TO
		Buffalo Bayou Watershed - continued		
Tributary 2.17 to Tributary 52.9 to Buffalo Bayou	T103-01-00	Tributary 52.9 to Buffalo Bayou	0.00	0.81
		Greens and Halls Bayous Watersheds		
Greens Bayou	P100-00-00	Buffalo Bayou	0.80	43.35
Big Gulch	P107-00-00	Greens Bayou	0.00	6.08
Sulphur Gully	P109-00-00	Greens Bayou	0.00	1.26
Spring Gully	P110-00-00	Greens Bayou	0.00	1.31
Halls Bayou	P118-00-00	Greens Bayou	0.00	19.36
Tributary 6.71 to Halls Bayou	P118-14-00	Halls Bayou	0.00	1.98
Tributary 11.96 to Halls Bayou	P118-23-00	Halls Bayou	0.00	1.45
Tributary 14.27 to Greens Bayou	P125-00-00	Greens Bayou	0.00	4.13
Tributary 14.82 to Greens Bayou	P126-00-00	Greens Bayou	0.00	3.95
Garners Bayou	P130-00-00	Greens Bayou	0.00	9.67
Williams Gully	P130-02-00	Garners Bayou	0.00	4.36
Tributary 2.01 to Williams Gully	P130-02-02	Williams Gully	0.00	1.91
Tributary 3.19 to Garners Bayou	P130-03-00	Garners Bayou	0.00	0.79
Tributary 0.55 to Tributary 3.19 to Garners Bayou	P130-03-01	Tributary 3.19 to Garners Bayou	0.00	0.18
Reinhardt Bayou	P130-05-00	Garners Bayou	0.00	3.75
Tributary 20.88 to Greens Bayou	P133-00-00	Greens Bayou	1.72	2.28
Tributary 24.97 to Greens Bayou	P138-00-00	Greens Bayou	0.00	4.92
Tributary 26.64 to Greens Bayou	P140-00-00	Greens Bayou	0.00	5.40
P155-00-00	P155-00-00	Greens Bayou	0.00	1.36
P156-00-00	P156-00-00	Greens Bayou	0.00	1.21
North Fork Greens Bayou	P145-00-00	Greens Bayou	0.00	4.52

TABLE 1 - SCOPE OF STUDY - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	STREAM MILE FROM	STREAM MILE TO
		Greens and Halls Bayous Watersheds - continued		
Tributary 1.95 to North Fork Greens Bayou	P145-03-00	North Fork Greens Bayou	0.00	2.70
Tributary 32.23 to Greens Bayou	P146-00-00	Greens Bayou	0.00	1.53
Tributary 34.60 to Greens Bayou	P148-00-00	Greens Bayou	0.00	1.53
		Sims and Brays Bayous Watersheds		
Sims Bayou	C100-00-00	Buffalo Bayou	0.00	24.05
Plum Creek	C102-00-00	Sims Bayou	0.00	1.75
Pine Gully	C103-00-00	Sims Bayou	0.00	2.58
Berry Bayou	C106-00-00	Sims Bayou	0.00	4.83
Berry Creek	C106-01-00	Berry Bayou	0.00	4.74
Tributary 2.00 to Berry Bayou	C106-03-00	Berry Bayou	0.00	1.78
Tributary 3.31 to Berry Bayou	C106-08-00	Berry Bayou	0.00	1.07
Tributary 10.12 to Sims Bayou	C118-00-00	Sims Bayou	0.00	1.10
Tributary 10.77 to Sims Bayou	C123-00-00	Sims Bayou	0.00	1.37
Tributary 13.83 to Sims Bayou	C132-00-00	Sims Bayou	0.00	0.86
Tributary 17.82 to Sims Bayou	C161-00-00	Sims Bayou	0.00	2.01
Tributary 20.25 to Sims Bayou	C147-00-00	Sims Bayou	0.00	1.46
Brays Bayou	D100-00-00	Buffalo Bayou	0.00	29.73
Willow Waterhole Bayou	D112-00-00	Brays Bayou	0.00	3.62
Chimney Rock Diversion Channel	D139-00-00	Brays Bayou	0.00	1.92
Tributary 17.42 to Brays Bayou	D133-00-00	Brays Bayou	0.00	1.99
Fondren Diversion Channel	D140-00-00	Brays Bayou	0.00	4.65
Keegans Bayou	D118-00-00	Brays Bayou	0.00	6.65

TABLE 1 - SCOPE OF STUDY - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	STREAM MILE FROM	STREAM MILE TO
Sims and Brays Bayous Watersheds - continued				
Tributary 19.77 to Brays Bayou	----------	Brays Bayou	0.00	1.56
Tributary 20.86 to Brays Bayou	D142-00-00	Brays Bayou	0.00	2.21
Tributary 20.90 to Brays Bayou	D120-00-00	Brays Bayou	0.00	2.79
Tributary 21.95 to Brays Bayou	D122-00-00	Brays Bayou	0.00	3.22
Tributary 22.69 to Brays Bayou	D124-00-00	Brays Bayou	0.00	1.60
Tributary 23.53 to Brays Bayou	D126-00-00	Brays Bayou	0.00	2.05
Tributary 26.20 to Brays Bayou	D129-00-00	Brays Bayou	0.00	3.22
Tributary 29.16 to Brays Bayou	D132-00-00	Brays Bayou	0.00	1.59
White Oak Bayou Watershed				
White Oak Bayou	E100-00-00	Buffalo Bayou	0.00	29.73
Little White Oak Bayou	E101-00-00	White Oak Bayou	0.00	8.33
Brickhouse Gully	E115-00-00	White Oak Bayou	0.00	6.05
Tributary 1.61 to Brickhouse Gully	E115-04-00	Brickhouse Gully	0.00	1.72
Tributary 10.1 to White Oak Bayou	E116-05-00	White Oak Bayou	0.00	1.61
Cole Creek	E117-00-00	White Oak Bayou	0.00	6.61
Vogel Creek	E121-00-00	White Oak Bayou	0.00	7.00
Tributary 15.8 to White Oak Bayou	E124-00-00	White Oak Bayou	0.00	3.10
Rolling Fork	E125-00-00	White Oak Bayou	0.00	4.42
Tributary 19.05 to White Oak Bayou	E127-00-00	White Oak Bayou	0.00	1.62
Tributary 19.82 to White Oak Bayou	E135-00-00	White Oak Bayou	0.00	1.74
Spring and Cypress Creeks Watersheds				
Spring Creek	J100-00-00	West Fork San Jacinto River	0.00	48.22
Bender Lake	----------	Spring Creek	0.00	1.68

TABLE 1 - SCOPE OF STUDY - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	STREAM MILE FROM	STREAM MILE TO
Spring and Cypress Creeks Watersheds - continued				
Tributary 21.08 to Spring Creek	J121-00-00	Spring Creek	0.00	0.50
Willow Creek	M100-00-00	Spring Creek	0.00	19.62
Tributary 0.26 to Willow Creek	M101-00-00	Willow Creek	0.00	0.62
Tributary 2.44 to Willow Creek	M104-00-00	Willow Creek	0.00	1.61
Hughes Gully	M108-00-00	Willow Creek	0.00	0.59
Cannon Gully	M109-00-00	Willow Creek	0.00	1.11
Metzler Creek	M109-01-00	Cannon Gully	0.00	0.69
Tributary 6.52 to Willow Creek	M112-00-00	Willow Creek	0.00	1.99
Tributary 8.16 to Willow Creek	M116-00-00	Willow Creek	0.00	1.18
Tributary 13.50 to Willow Creek	M124-00-00	Willow Creek	0.00	2.57
Boggs Gully	J131-00-00	Spring Creek	0.00	3.88
Tributary 1.25 to Boggs Gully	----------	Boggs Gully	0.00	1.11
Cypress Creek	K100-00-00	Spring Creek	0.00	47.31
Turkey Creek	K111-00-00	Cypress Creek	0.00	6.31
Wild Cow Gulch	K112-00-00	Cypress Creek	0.00	2.00
Schultz Gully	K116-00-00	Cypress Creek	0.00	1.04
Lemm Gully	K120-00-00	Cypress Creek	0.00	3.05
Senger Gully	K120-01-00	Lemm Gully	0.00	3.01
Wunsche Gully	K120-03-00	Lemm Gully	0.00	1.91
Seals Gully	K124-00-00	Cypress Creek	0.00	4.15
Kothman Gully	K124-02-00	Seals Gully	0.00	2.82
Spring Gully	K131-00-00	Cypress Creek	0.00	4.52
Theiss Gully	K131-02-00	Spring Gully	0.00	4.97
Tributary 2.1 to Spring Gully	K131-03-00	Spring Gully	0.00	1.90
Dry Gully	K133-00-00	Cypress Creek	0.00	2.83
Pillot Gully	K140-00-00	Cypress Creek	0.00	3.80
Faulkey Gully	K142-00-00	Cypress Creek	0.00	5.67
Little Cypress Creek	L100-00-00	Cypress Creek	0.00	20.55
Tributary 9.36 to Little Cypress Creek	L109-00-00	Little Cypress Creek	0.00	0.95

TABLE 1 - SCOPE OF STUDY - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	STREAM MILE FROM	STREAM MILE TO
Spring and Cypress Creeks Watersheds - continued				
Tributary 10.99 to Little Cypress Creek	L112-00-00	Little Cypress Creek	0.00	2.09
Tributary 13.92 to Little Cypress Creek	L114-00-00	Little Cypress Creek	0.00	2.54
Tributary 0.12 to Tributary 13.92 to Little Cypress Creek	L114-01-00	Tributary 13.92 to Little Cypress Creek	0.00	1.13
Dry Creek	K145-00-00	Cypress Creek	0.00	4.51
Tributary 36.6 to Cypress Creek	K150-00-00	Cypress Creek	0.00	2.41
Tributary 37.1 to Cypress Creek	K152-00-00	Cypress Creek	0.00	1.16
Channel A to Cypress Creek	K159-00-00	Cypress Creek	0.00	2.73
Channel D to Channel A to Cypress Creek	K159-01-00	Channel A to Cypress Creek	0.00	9.19
Tributary 40.7 to Cypress Creek	K155-00-00	Cypress Creek	0.00	3.23
Tributary 42.7 to Cypress Creek	K157-00-00	Cypress Creek	0.00	3.65
Rock Hollow	K160-00-00	Cypress Creek	0.00	5.79
Tributary 1.63 to Rock Hollow	----------	Rock Hollow	0.00	2.63
Tributary 44.5 to Cypress Creek	----------	Cypress Creek	0.00	5.06
Mound Creek	K166-00-00	Cypress Creek	0.95	5.51
Little Mound Creek	----------	Mound Creek	0.00	2.58
Tributary 7.62 to Mound Creek	----------	Mound Creek	0.00	0.97
Tributary 8.18 to Mound Creek	----------	Mound Creek	1.67	2.78

TABLE 1 - SCOPE OF STUDY - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	STREAM MILE FROM	STREAM MILE TO
		Cedar Bayou Watershed		
Cedar Bayou	Q100-00-00	Galveston Bay	0.00	39.89
Pine Gully	Q101-00-00	Cedar Bayou	0.00	21.00
Diversion Channel	----------	Cedar Bayou	0.00	0.99
Cary Bayou	Q112-00-00	Cedar Bayou	0.00	3.14
McGee Gully	Q114-00-00	Cedar Bayou	0.00	3.18
		Little Cedar Bayou Watershed		
Little Cedar Bayou	F216-00-00	Galveston Bay	0.13	3.14
		Mustang Bayou Watershed		
Mustang Bayou	---------	Chocolate Bay	7.35	7.75

Tidal flooding including its wave action was studied by detailed methods along the northern shore of Clear Lake, from its confluence with Galveston Bay to just past the confluence of Clear Creek; along Taylor Lake, from its confluence with Clear Lake to the confluence of Taylor Bayou; along Forrest Lake, from its confluence with Clear Lake to just past the confluence of Armand Bayou; along Galveston Bay, from the confluence of Clear Lake to the confluence of Cedar Bayou; along the shoreline of Ash Lake; along the San Jacinto River, from its confluence with Galveston Bay to Bear Lake above Interstate Route 10; and along Buffalo Bayou, from its confluence with the San Jacinto River to just past the confluence of Carpenters Bayou.

Tidal flooding without the effects of wave action was studied by detailed methods along Taylor Bayou including Taylor Lake, Forrest Lake, Clear Creek, the San Jacinto River, Buffalo Bayou, Greens Bayou, Halls Bayou, Ash Lake, and Cedar Bayou. Combined riverine and surge flooding were studied for all areas where riverine and surge flooding interface.

This revision was carried out in order to include the incorporated areas of Harris County in a countywide Flood Insurance Study; as part of this revision, updated analyses were inlcuded for the flooding sources shown in the following tabulation.

Flooding Source	Limits of Revised Detailed Study
Brays Bayou	From mile 0.00 to mile 29.73
Greens Bayou	From a point immediately upstream of Tidwell Road to mile 43.35

Flooding Source	Limits of Revised Detailed Study
Halls Bayou	From mile 0.00 to mile 19.36
Garners Bayou	From mile 0.00 to mile 9.67
Tributary 26.20 to Brays Bayou	From mile 0.00 to mile 3.22
Spring Branch	From Long Point Road to Campbell Road
Turkey Creek (A119-00-00)	From mile 0.00 to mile 4.42
Halls Road Ditch	From mile 0.00 to mile 5.51
Tributary 9.39 to Armand Bayou	From mile 0.00 to mile 1.89
Tributary 4.51 to Horsepen Bayou	From mile 0.00 to mile 1.59
Cypress Creek	From mile 35.1 to mile 38.8
Dry Creek	From mile 0.00 to mile 4.51
Tributary 37.1 to Cypress Creek	From mile 0.00 to mile 1.16
Tributary 26.64 to Greens Bayou	From mile 0.00 to mile 5.40
Willow Creek	From mile 5.6 to mile 7.9
Cypress Creek	From mile 22.5 to mile 24.3 (south bank), and from mile 22.4 to mile 23.6 (north bank)
White Oak Bayou	From mile 3.7 to mile 4.6
North shore of Burnett Bay	Entire shoreline within county
East Fork San Jacinto River	From mile 18.9 to upstream limit of flooding affecting the county
Sims Bayou	From mile 15.72 to mile 18.93
Clodine Ditch	Entire length within the county
Buffalo Bayou	From mile 45.89 to mile 47.52

In this revision, new hydrologic and hydraulic analyses were added for the following streams: Channel A to Cypress Creek, Channel D to Channel A to Cypress Creek, P155-00-00, and P156-00-00.

The analyses for the following streams, within the communities in parentheses, were updated to match more recent flooding information in adjacent communities: Buffalo Bayou (Bunker Hill Village); Willow Springs Bayou and Tributary 1.78 to Willow Springs Bayou (Deer Park); Tributary 3.19 to Garners Bayou and Tributary 0.55 to Tributary 3.19 to Garners Bayou (Humble); Buffalo Bayou and Briar Branch (Hunters Creek Village); Cow Bayou (Nassau Bay and Webster); Big Island Slough and Horsepen Bayou (Pasadena); and Buffalo Bayou (Piney Point Village).

The effects of the following projects, for which FEMA has issued letters of intent to revise the FIRM, were also incorporated into this revised study: channel modifications to Greens Bayou; watershed modifications for Taylor Gully; channel modifications to Turkey Creek (K111-00-00); construction of the Addicks Reservoir Diversion Channel, and realignment of Langham Creek, carried out as the result of the construction of a bridge; fill placement adjacent to Horsepen Creek; a channel realignment on Tributary 10 08 to Clear Creek; a redelineation of the 100-year floodplain boundaries for Cedar Bayou, based on updated topographic information; and a redelineation of the floodway and 100- and 500-year floodplain boundaries for Brickhouse Gully, based on a drainage study.

This revision also incorporates the determinations of Letters of Map Revision (LOMR) issued by FEMA, on the dates in parentheses, for the following projects: channel modifications and fill on Greens Bayou (Harris County - November 2, 1987, reissued August 1, 1988; City of Houston - November 2, 1987); channel modifications on Carpenters Bayou (October 2, 1987, reissued February 5, 1988); a fill project on Cypress Creek (April 4, 1988); a split-flow analysis of Buffalo Bayou (October 5, 1987); a redelineation of the 100-year floodplain boundaries for Armand Bayou, based on updated topographic information (June 4, 1987); channel modifications to Horsepen Bayou (City of Houston - February 2, 1987; City of Pasadena - February 11, 1987); revisions made to Taylor Bayou in the Flood Insurance Study for the City of Shoreacres, including the reduction of the floodway, based on an updated hydrologic methodology (July 25, 1984); a redelineation of the 100- and 500-year floodplain boundaries for Cedar Bayou and Adlong Ditch, based on updated topographic information (February 11, 1987); and a redelineation of 100-year and 500-year floodplain boundaries for White Oak Bayou and Vogel Creek, based on updated topographic information (October 22, 1987).

This revision also incorporates the determinations of Letters of Map Amendment (LOMA) issued by FEMA for the following projects: Champions Racquet Club on Cypress Creek; the Rolling Fork project on Rolling Fork; Bay Forest-Section 3 on Horsepen Bayou; Wimbledon Park

subdivision on Cypress Creek; Bay Oaks on Horsepen Bayou; North-Northwest General Hospital on Hunting Bayou and Tributary 12.05 to Hunting Bayou; and Lakewood Forrest on Cypress Creek. All other LOMAs issued since the last map revision have been incorporated into this Flood Insurance Study. However, they do not appear on the FIRM for this study because of graphical limitations.

Corporate limits information has been updated in this revision to reflect the annexation of unincorporated areas of the county by the Cities of Baytown, Jersey Village, and La Porte, and the deannexation of land by the City of La Porte.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Portions of several flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Harris County.

2.2 Community Description

Harris County is located in southeast Texas approximately 24 miles inland from the Gulf of Mexico. Harris County is bordered by the unincorporated areas of the following counties: Chambers County to the east, Galveston County to the south, Brazoria County to the south, Fort Bend County to the southwest, Waller County to the north and west, Montgomery County to the north and Liberty County to the east. Galveston Bay forms a portion of the eastern county boundary. Harris is one of six counties forming the federally designated Houston Metropolitan Area consisting of Harris, Brazoria, Fort Bend, Liberty, Montgomery and Waller Counties. The metropolitan area had a population of 2,905,350 in 1980. The City of Houston, the largest city in Harris County, had a 1980 population of 1,594,086. The unincorporated area of the county had a 1980 population of 186,860. Harris County contains 28 incorporated communities in addition to Houston, with a combined population of 1,922,684 in 1980.

Drainage and flood control are governed by the HCFCD. The county's floodplain management and permit programs are administered by the county engineer with technical assistance from the HCFCD. Both of the previously mentioned agencies are under the jurisdiction of the Commissioners Court.

Harris County is highly industrialized, with more than 2,800 manufacturing plants producing a wide variety of products. The county is a corporate managerial center, has the largest concentration of petrochemical plants in the country, and is the second largest U. S. seaport. Harris County produces $55 million annually in agricultural products and is one of the leading producers of mineral products in the country (Reference 2.2.1).

The topography of the area is relatively flat, ranging from coastal salt marsh and sand flats along the bay shoreline to gently rolling coastal prairie in the northern and western portions of the county. Large areas of natural vegetation have been replaced by lawn grasses, trees and shrubs due to heavy urbanization and agricultural land uses in the county. The remaining natural vegetation is comprised of mixed hardwood and pine forest, coastal prairie grasses, marsh, and tall grasses (Reference 2.2.1).

The climate of the area is characterized by warm summers and mild winters. The normal annual temperature for Harris County was 68.9 degrees Fahrenheit (^{o}F) for the years 1941 through 1970 (normal is defined as the 30-year average of the mean daily temperature). Over the same period, the highest monthly average temperature was 83.4^{o}F for the month of August and the lowest was 52.1^{o}F for January. The average annual rainfall was 48.19 inches (Reference 2.2.2).

The most recent phase of geologic history to affect the study area was the Late Wisconsin glacial stage, when the sea level dropped during this last period of glaciation. Rivers built deltas along the new shoreline on the continental shelf, since they could no longer shift from their courses. Deep, broad valleys were cut across the earlier fluvial and delta plains. As the last glacial period diminished approximately 18,000 years ago, sea level began its most recent rise. Large point-bar sand bodies and extensive overbank mud sheets were deposited as rivers meandered within the filling valleys.

In the last 4,500 years, sea level has been relatively constant, probably changing in elevation only 10 to 15 feet. In modern times, the study area has evolved to its present condition by erosion, deposition, compaction and subsidence. These processes are still important and are operating today (References 2.2.3, 2.2.4 and 2.2.5).

Harris County is divided into 8 major watersheds. The watersheds include Clear Creek, the San Jacinto River, Buffalo Bayou, Greens and Halls Bayous, Sims and Brays Bayous, White Oak Bayou, Spring and Cypress Creeks, and Cedar Bayou.

Clear Creek originates in Fort Bend County and forms the boundary between Harris County and Brazoria and Galveston Counties as it flows east to Galveston Bay. The watershed, with an area of approximately 260 square miles, is approximately 45 miles long and varies in width from approximately 2.0 miles at its upper end to a maximum of approximately 13.5 miles near its midpoint.

The San Jacinto River is formed by the junction of the West and East Forks approximately eight miles upstream of Lake Houston Dam in

northeast Harris County. The river drains a trapezoidal area approximately 65 miles wide and 60 miles long, with an area of approximately 2,900 square miles at its confluence with Buffalo Bayou. The terrain in this watershed varies from prairie to gently rolling and hilly, and is covered with timber and brush grazing lands. The watershed ranges in elevation from approximately 5 feet near Lynchburg Landing to approximately 20 feet in the valley near Lake Houston Dam, to a maximum of approximately 400 feet at the headwater divide. The principal streams in the San Jacinto River watershed are relatively shallow and sluggish with small sand-bottomed channels and wide, flat valleys.

The Buffalo Bayou watershed above Addicks and Barker Reservoirs lies primarily in southwest Harris and northeast Fort Bend Counties. This watershed is bordered on the south by Jones and Oyster Creeks, on the west by Bessies Creek, and on the east by Addicks and Barkers Dams. The Buffalo Bayou watershed above Addicks and Barker Reservoirs, roughly trapezoidal in shape with a land area of approximately 130 square miles, is approximately 13 miles long with an average width of 6 miles. Ground elevations vary from 200 feet at the upstream divide to approximately 73 feet at Barker Dam. Streams slope uniformly south at approximately 5 feet per mile within the watershed. The streams in this area are characterized by channels containing a dense growth of weeds. The overbanks in this area are usually flat and lined with a heavy growth of trees, heavy weeds and scattered brush. These natural conditions have been replaced by residential communities and rectified channels in many locations.

The lower portion of Buffalo Bayou lies primarily within Harris County with the exception of the upper portions of Clodine Ditch, which extends into Fort Bend County. This portion of the Buffalo Bayou watershed is bordered on the north by the White Oak Bayou, Greens Bayou, and Halls Bayou watersheds and on the south by the Sims Bayou and Brays and Clear Creek watersheds. The natural streams in the lower portions, below the turning basin, of Buffalo Bayou watershed are characterized by channels containing little or no vegetation while some contain a dense growth of weeds. The overbanks are flat with land uses ranging from heavy petrochemical industrialization to light industrialization. The natural streams above the turning basin are characterized by channels containing moderate to dense vegetation. The overbanks are flat with land uses ranging from moderate to heavy urbanization. The total drainage area of the Buffalo Bayou watershed is approximately 768 square miles.

The Greens Bayou watershed has a drainage area of approximately 207 square miles and lies entirely within Harris County. The watershed is bordered by the Spring and Cypress Creeks watersheds to the north and the White Oak Bayou watershed to the south.

The natural streams in the Greens Bayou watershed are characterized by channels containing moderate to dense vegetation and generally very flat overbanks with land uses varying from highly urbanized to dense vegetation. Greens Bayou flows east from its headwaters approximately 23.4 miles and then turns south for approximately 18.7 miles to its confluence with Buffalo Bayou.

Tributaries to Greens Bayou below river mile 15 are characterized by deeply entrenched channels near their confluences and shallow, narrow, man-made ditches upstream. The tributaries to Greens Bayou above river mile 15 are generally shallow ditches with light to dense vegetation. The overbanks on all the tributaries are flat and have varied land uses ranging from heavy urbanization to rural areas with dense vegetation.

Halls Bayou, a tributary to Greens Bayou at river mile 11.86, flows east-southeast for approximately 20.1 miles. The lower 10.9 miles of Halls Bayou flow within the corporate limits of the City of Houston, while the remaining 9.2 miles flow within the unincorporated areas of Harris County. The downstream portions of Halls Bayou are characterized by heavily wooded overbanks and large meandering channels, while the upstream portions of the stream have highly urbanized overbanks and grass lined channels with some meandering.

Brays Bayou originates in southwestern Harris County and flows east for a distance of approximately 32 miles to its confluence with Buffalo Bayou at river mile 14.0. The Brays Bayou watershed is bordered on the north by Buffalo Bayou and on the south by Clear Creek. The total drainage area of Brays Bayou is approximately 130 square miles. The natural streams in the Brays Bayou watershed are characterized by channels containing a moderate to dense growth of weeds. At some locations, the overbank areas are lined with a heavy growth of trees. Brays Bayou, between its confluence with Buffalo Bayou and river mile 25.4, has been rectified and lined as a part of a Federal flood control project. The remaining natural overbanks are flat and are moderately to highly urbanized.

The White Oak Bayou watershed has a drainage area of approximately 110 square miles and is located in north-central Harris County. The majority of the watershed is highly urbanized with the exception of the upper reaches in the northwestern portion of the watershed. This area, although still relatively rural in character, is rapidly being developed. The channel system has been modified to accomodate the urban development in the watershed. The main stem of White Oak Bayou has been improved as a concrete-lined channel, and major tributaries have been either lined or expanded as earthen channels.

The smaller tributaries and upper portions of Little White Oak Bayou are relatively unimproved. White Oak Bayou is a major tributary of Buffalo Bayou. The bayou originates in northwest Harris County and flows southeast for approximately 25 miles into the City of Houston. White Oak Bayou joins Buffalo Bayou near the central business district of the city.

Spring Creek forms the boundary between Waller, Montgomery and Harris Counties. From its headwaters in northeast Waller County, the stream flows east for approximately 68 miles to its confluence with West Fork San Jacinto River. The watershed slopes from an elevation of approximately 330 feet in the upstream portions of the stream to an elevation of approximately 50 feet at its confluence with West Fork San Jacinto River. The watershed, including Cypress Creek, has a drainage area of approximately 760 square miles at its mouth. Upstream of the confluence of Cypress Creek, the watershed has a width of approximately 16 miles, a length of approximately 66 miles, and a drainage area of approximately 438 square miles. Land in the watershed is primarily forest with some minor cultivation. Some urbanization has occurred in the areas at and downstream of the stream gage at Spring, Texas.

Cypress Creek, a major tributary to Spring Creek, is located in the northern portion of Harris County and the southeast corner of Waller County. The creek is formed by the junction of Snake and Mound Creeks in Waller County. Cypress Creek flows east for approximately 54 miles to its confluence with Spring Creek. The lower 50 miles are located in Harris County. The drainage area of Cypress Creek is approximately 319 square miles. Approximately 45 square miles of the drainage area are located above the confluence of Snake and Mound Creeks. The Cypress Creek watershed slopes gently to the east-northeast. Above U. S. Route 290, the watershed consists of prairie used for rice production and pasture. Below U. S. Route 290, the watershed is heavily wooded and provides sites for residential development. Elevations in the watershed vary from approximately 310 feet near the headwaters of Mound Creek to approximately 60 feet at the mouth of Cypress Creek.

Willow Creek, a major tributary of Spring Creek, originates approximately 7 miles southwest of the City of Tomball in Harris County and elevations range from approximately 310 feet near the headwaters of Mound Creek to approximately 60 feet at the mouth of Cypress Creek.

Cedar Bayou is located between the downstream portions of the Trinity and San Jacinto Rivers and forms the boundary between Harris County and the counties of Chambers and Liberty. From its source in west-central Liberty County, Cedar Bayou meanders south through

prairies and heavily wooded land into upper Galveston Bay. The bayou has a length of approximately 51 miles and a drainage area of approximately 212 square miles. Elevations in the watershed range from 95 feet at the upstream portion of the watershed to 15 feet at the confluence of Cedar Bayou with Galveston Bay.

2.3 Principal Flood Problems

Harris County is subject to intense local thunderstorms of short duration, general storms extending over periods of several days, and torrential rainfall associated with hurricanes and other tropical disturbances. Flooding in the county results from tidal surge along Galveston Bay caused by hurricanes and tropical storms and from stream overflow. Hurricane Carla in 1961 produced stillwater elevations of 14-16 feet along the shoreline of Harris County, 14-19 feet in the San Jacinto River and along Buffalo Bayou, and over 10 feet in Clear Lake (Reference 2.3.1). In 1979, Tropical Storm Claudette produced a tidal surge of approximately 2.5 feet in Galveston Bay at Seabrook, but produced widespread flooding in the Clear Creek watershed in Harris County (Reference 2.3.2).

2.4 Flood Protection Measures

Federal flood control projects in Harris County include channel rectification on portions of Buffalo Bayou and its tributaries, Brays and White Oak Bayous, and Addicks and Barker Reservoirs. These projects provide flood protection primarily for the City of Houston. Numerous channel improvement projects have been constructed and are maintained by the HCFCD. Lake Houston, in the northeastern portion of the county, was constructed by the City of Houston for industrial and municipal water supply. It contains no designated flood control storage capacity and does not provide downstream flood protection.

The diversion channel along Langham Creek is being used as a flood protection measure for flows having recurrence intervals of less than 100 years; these flows are diverted from the natural channel course directly into Addicks Reservoir.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between

floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the county.

The hydrologic analyses for this study were developed by the COE and the HCFCD. From 1977 to 1979, the COE developed various hydrologic methodologies for all the watersheds within the county. In 1983, the HCFCD developed revised methodologies to reflect the rapid development that had occurred in the county since 1979. Only the areas that experienced significant improvements or changes were restudied. Table 2, "Summary of Hydrologic Methods," lists all the flooding sources studied by detailed methods and the agency that performed the hydrologic analyses. Further, the agency that performed the hydrologic analyses also performed the hydraulic analyses and mapping. The hydrologic methodologies are explained and summarized in the following pages.

HCFCD HYDROLOGY

Two major hydrologic methodologies were developed by the HCFCD for the streams studied by detailed methods. The first methodology was developed for drainage areas of greater than 10 square miles, while the second was developed for drainage areas of less than 10 square miles. In addition, another methodology was developed for the Upper Brays Bayou watershed. A detailed description of these hydrologic analyses is available to the public through the HCFCD (Reference 3.1.1). A summary of these methodologies is presented below.

Drainage Areas Greater than 10 Square Miles

The HEC-1 computer program was used for drainage areas greater than 10 square miles (Reference 3.1.2). The purpose of the HEC-1 program is to determine peak discharges at various locations within a

watershed. The most useful feature of the program is its capacity to model flood runoff from a single storm event for a complex river basin. To model a basin, topologic features must be described, and the precipitation runoff parameters must be defined and entered into the computer program. The topologic features include drainage basin boundaries, stream channels, and relationships between drainage areas and stream channels. Average rainfall values are used for each sub-basin. Runoff is computed from average basin parameters; therefore, a unit hydrograph and a loss rate criterion is required. The program considers routing to be governed by storage and can be computed by one of several hydrologic methods, each with its own set of parameters.

The process of the HEC-1 program includes inputting and distributing the precipitation, determining the sub-basin outflow hydrographs from unit hydrograph methods, computing rainfall and excess values, and routing hydrographs by hydrologic methods. This hydrologic methodology was used to develop the discharges for most of the county. The Clark's unit hydrograph parameters of time of concentration (T_c) and attenuation constant (R) were optimized from a regression analysis evaluating the storm events obtained at various gages. Percent of urbanization was taken into account by separating the above data into three categories: (1)undeveloped, (2) partially developed, and (3) developed conditions.

The regression analysis described above showed the equation for T_c to be a function of overbank slope, length to centroid of area, urbanization, and weighted channel slope; the equation for $T_c + R$ was found to be a function of the length of the watershed to the divide, the weighted channel slope, urbanization, and channel conveyance. Ponding, caused by extensive rice farming in the southern and western portions of the county, was taken into account by developing a relationship between percent ponding and R. This relationship was obtained from the U. S. Soil Conservation Service (SCS) Technical Release 55 (Reference 3.1.3). The SCS methodology that incorporates the use of runoff curve numbers and soil type was used to estimate loss rates (Reference 3.1.4).

Drainage Areas Less than 10 Square Miles

Drainage area-discharge curves were developed for each watershed with a drainage area of less than 10 square miles. These curves are based on an average watershed channel slope and an average watershed overbank slope.

Unit hydrograph coefficients of T_c and R were calculated using the equations developed by the HCFCD (Reference 3.1.1). To determine

the length to watershed divide and the length to centroid of axis, a regression analysis was performed between these values and the drainage area, yielding a high correlation.

A HEC-1 model using the kinematic wave option was constructed for different drainage areas using design storm rainfalls and loss rates. The computed flows were plotted on full-log graph paper, which resulted in the final drainage area-discharge curves for the watershed.

Upper Brays Bayou Watershed

Peak discharges for floods of the selected recurrence intervals were developed in a 1982 hydrologic analysis conducted for the Upper Brays Bayou watershed. The HEC-1 computer program, with USGS rainfall and streamflow data, was used to calibrate values for exponential loss rate parameters and Clark's unit hydrograph parameters. Correlations were found between rainfall loss rates and degree of development, as well as rainfall depth and watershed storage. The modified Puls routing method, using storage/outflow data from a backwater model, was selected for routing the hydrographs.

COE HYDROLOGY

The hydrologic methodologies developed by the COE for the streams studied by detailed methods are outlined below.

T-Year Equations

A set of regression equations were developed that relate the 10-, 50-, 100-, and 500-year recurrence interval floods for urbanized watersheds within Harris County to contributing drainage area and effective channel conveyance at the point of computation. To develop these equations, the COE estimated discharges of the desired recurrence intervals for 19 ungaged basins in the Houston metropolitan area using the annual maximum discharges at each gage. Streamflow records from the following gages were used in the analyses:

USGS Gaging Station	Location
No. 08074150	Cole Creek at Deihl Road, Houston
No. 08074200	Brickhouse Gully at Clarblak Street, Houston
No. 08074250	Brickhouse Gully at Costa Rica Street, Houston

USGS Gaging Station	Location
No. 08074500	White Oak Bayou at Houston
No. 08074780	Keegans Bayou at Keegans Road, Houston
No. 08074800	Keegans Bayou at Roark Road, Houston
No. 08075000	Brays Bayou at Houston
No. 08075400	Sims Bayou at Hiram Clark Street, Houston
No. 08075500	Sims Bayou at Houston
No. 08075550	Berry Bayou at Gilpin Street, Houston
No. 08075650	Berry Bayou at Forest Oaks Street, Houston
No. 08075760	Hunting Bayou at Falls Street, Houston
No. 08075780	Greens Bayou at Cutten Road, Houston
No. 08075900	Greens Bayou at U. S. Route 75, Houston
No. 08076000	Greens Bayou near Houston
No. 08076200	Halls Bayou at Deertrail Street, Houston
No. 08076500	Halls Bayou at Houston
No. 08076700	Greens Bayou at Ley Road, Houston
No. 08077100	Clear Creek tributary at Hall Road, Houston

Multiple linear regression techniques were used to relate the selected frequency discharges at each gage, determined with log-Pearson Type III analyses, to the contributing drainage area, the percent of development, and the effective channel conveyance (Reference 3.1.5). The results of the regression analyses were four arithmetic expressions equating the resulting peak flows to functions of the basin drainage area and effective channel conveyance. The variable percent development was found to be insignificant in the regression analyses, and, therefore, was deleted. The regression equations are shown below:

$$Q_{10} = 0.823616\ A^{0.333983}\ K^{0.595295}$$
$$Q_{50} = 1.892252\ A^{0.348072}\ K^{0.565411}$$
$$Q_{100} = 3.757509\ A^{0.377746}\ K^{0.519703}$$
$$Q_{500} = 21.744078\ A^{0.468431}\ K^{0.394372}$$

where Q_x is the discharge of the desired recurrence interval (x), A is the contributing drainage area, and K is the effective channel conveyance computed at the bank full stage. To avoid the unwarranted values of peak discharges that might result from erratic conveyance values, bank full conveyance, computed with the HEC-2 step-backwater computer program, was plotted against river mile and a smooth curve through these points was developed (Reference 3.1.6).

These analyses were conducted solely to develop flood discharges for Harris County, and the resulting equations are not suitable for general application. These equations are similar to those developed by the USGS and described in Water Resources Investigations 3-73 and Publication No. 80-17 (Reference 3.1.7 and 3.1.8). In general, the equations developed by the COE produce higher flows than the USGS equations, because the COE equations have been calibrated to frequency curves that were adjusted for the Probable Maximum Flood (PMF) having a recurrence interval assigned at 10,000 years. In some instances, the flows computed with this procedure required adjustment to account for watershed overflows.

HEC-1 Computer Program

A general overview of the HEC-1 model was given in the HCFCD hydrologic section; however, the COE used different assumptions in applying HEC-1 for different groups of streams. These differences are described below.

HEC-1 Method A

To establish the 10-, 50-, 100- and 500-year floods, a log-Pearson Type III analysis was performed on the following gages.

USGS Gaging Station	Location
No. 08068000	West Fork San Jacinto River near Conroe, Texas
No. 08068500	Spring Creek near Spring, Texas
No. 08069000	Cypress Creek near Westfield, Texas
No. 08069500	West Fork San Jacinto River near Humble, Texas
No. 08070000	East Fork San Jacinto River near Cleveland, Texas
No. 08070500	Caney Creek near Splendora, Texas
No. 08071000	Peach Creek near Splendora, Texas
No. 08071500	San Jacinto River near Huffman, Texas

The skew coefficient for the Spring Creek gage was determined in accordance with Bulletin 17A (Reference 3.1.5). The skew coefficients for the other gages were determined to reflect that the PMF (QMAX) would have a recurrence interval of 1 in 10,000 years. QMAX was developed using HEC-1 with the revision for overflow developed by the Southwestern Division of the COE for the Lake Houston area, Spring Creek, and Cypress Creek. The Southwestern Division computer program QUIKII was used to model the other basins.

For ungaged areas, rainfall exceedence frequencies were developed from a regression analysis using the results from multiple HEC-1 runs and the QMAX weighted frequency curve of the following gages.

USGS Gaging Station	Location
No. 08068000	West Fork San Jacinto River near Conroe, Texas
No. 08068500	Spring Creek near Spring, Texas
No. 08069500	West Fork San Jacinto River near Humble, Texas
No. 08070000	East Fork San Jacinto River near Cleveland, Texas
No. 08070500	Caney Creek near Splendora, Texas
No. 08071000	Peach Creek at Splendora, Texas
No. 08071500	San Jacinto River near Huffman, Texas
No. 08072500	Barker Reservoir near Addicks, Texas
No. 08073000	Addicks Reservoir near Addicks, Texas
No. 08115000	Big Creek near Needville, Texas
No. 08116400	Dry Creek near Rosenberg, Texas

The regression analyses used drainage area, length, length to centroid, main channel slope, and mean basin elevation as possible parameters. The regression analyses disclosed that the drainage area and mean basin elevation were the characteristics that best explained the variation in the rainfall exceedence frequencies. The adopted equations follow:

$$\text{10-year rainfall} = (\text{PMS})\,(0.00485)\,(\text{DA}^{0.2933})\,(\text{EL}^{1.1832})\,(1/100)$$
$$\text{50-year rainfall} = (\text{PMS})\,(0.0093)\,(\text{DA}^{0.2644})\,(\text{EL}^{1.2013})\,(1/100)$$
$$\text{100-year rainfall} = (\text{PMS})\,(0.0357)\,(\text{DA}^{0.2247})\,(\text{EL}^{1.03075})\,(1/100)$$
$$\text{500-year rainfall} = (\text{PMS})\,(0.8284)\,(\text{DA}^{0.1426})\,(\text{EL}^{0.6075})\,(1/100)$$

where PMS is probable maximum storm, in inches; DA is drainage area, in square miles; and EL is the mean basin elevation, in feet.

These equations compared favorably to USGS gage No. 08069000, on Cypress Creek near Westfield, Texas.

For both the gaged and ungaged areas, the HEC-1 model was used to develop the 10-, 50-, 100- and 500-year flood discharges. To determine the basin runoff parameters a regional analysis was performed on the following USGS gages.

USGS Gaging Station	Location
No. 08073000	Addicks Reservoir near Addicks, Texas
No. 08072500	Barker Reservoir near Addicks, Texas
No. 08115000	Big Creek near Needville, Texas

USGS Gaging Station	Location
No. 08072400	Buffalo Bayou near Clodine, Texas
No. 08070500	Caney Creek near Splendora, Texas
No. 08077000	Clear Creek near Pearland, Texas
No. 08077550	Cowart Creek near Friendswood, Texas
No. 08116400	Dry Creek near Rosenberg, Texas
No. 08115500	Fairchild Creek near Needville, Texas
No. 08075780	Greens Bayou at Cutten Road, Houston, Texas
No. 08075900	Greens Bayou at U. S. Route 75, Houston, Texas
No. 08074780	Keegans Bayou near Keegans Road, Houston, Texas
No. 08067750	Langham Creek Tributary near Montgomery,Texas
No. 08072800	Langham Creek near Addicks, Texas
No. 08068300	Mill Creek Tributary near Dobbin, Texas
No. 08068450	Panther Creek at Splendora
No. 08071000	Peach Creek at Splendora
No. 08114900	Seabourne Creek near Rosenberg, Texas
No. 08072700	South Mayde Creek near Addicks, Texas
No. 08068500	Spring Creek near Spring, Texas

The drainage areas of these basins varied from 0.13 to 409.3 square miles. Values for Clark's coefficients, T_c (time of concentration), and R (attenuation constant) were calculated for a total of 136 storms that occurred over the study area between 1945 and 1975. These storms produced from 0.59 to 14.36 inches of total basin average rainfall. Computations were performed using the HEC-1 "Loss Rate and Unit Graph Optimization."

The results of these regression analyses are shown below:

$$T_c + R = C_1(31.3648\ Lca^{0.478}/S^{0.592})$$

$$R/(T_c + R) = C_2(2.0576/[DA^{0.239}\ S^{0.326}])$$

QRSCN = 10 percent of peak discharge

log RTIOR = (log DA -2.63)/-6.92

where T_c is the time of concentration,
R is the attenuation constant,
Lca is the length to centroid in miles,
S is the slope in feet per mile,
DA is the drainage area in square miles,
C_1 is the map coefficient for $T_c + R$ shown in Figure 2,
C_2 is the map coefficient for $R/(T_c + R)$ shown in Figure 3,
QRCSN is the flow in cubic feet per second (cfs) below which recession can control (Reference 3.1.2), and
RTIOR is the ratio of recession flow to that 10 intervals later (Reference 3.1.2)

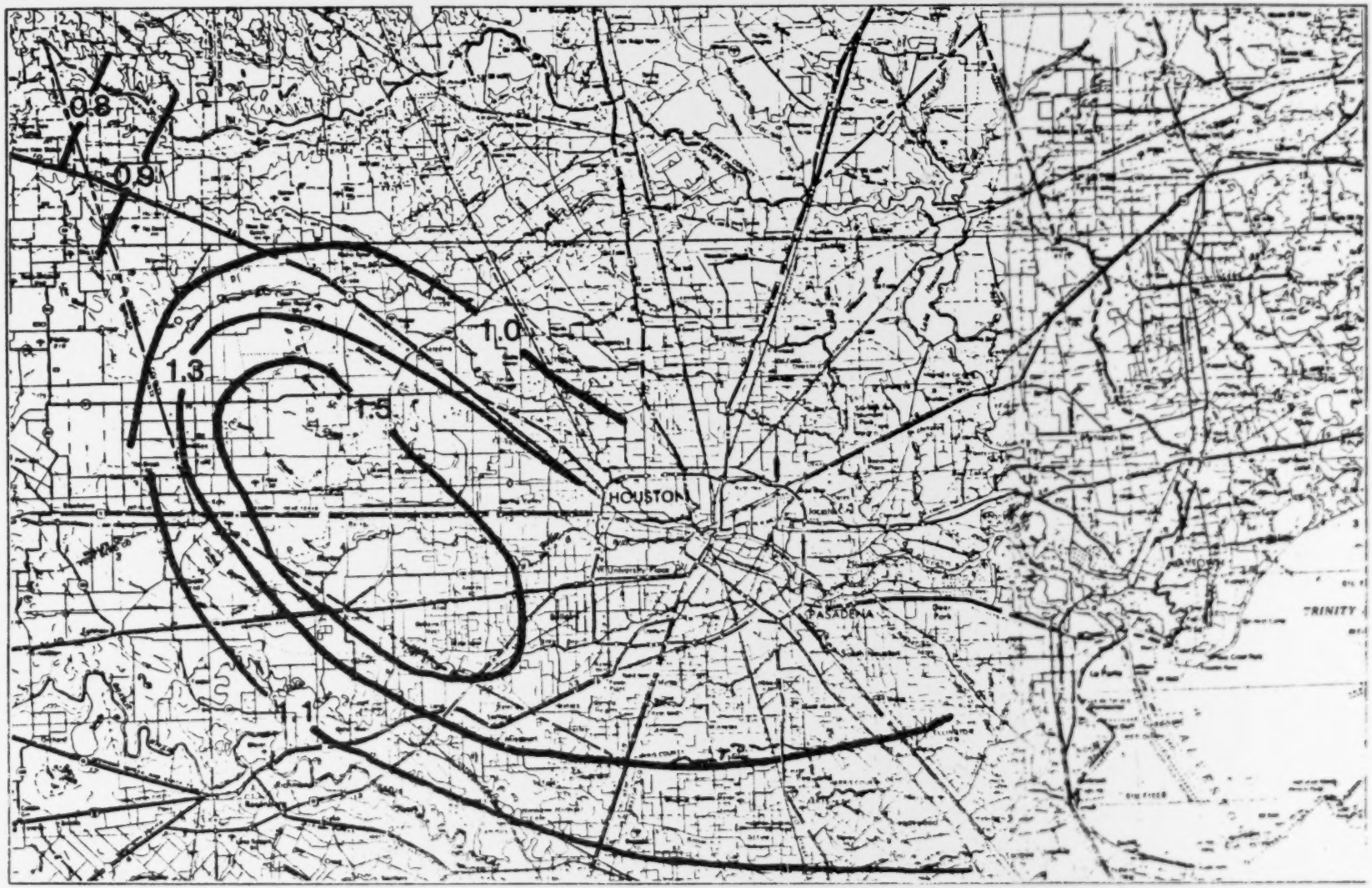


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRIS COUNTY, TX
AND INCORPORATED AREAS

APPROXIMATE SCALE

MAP COEFFICIENT - C1

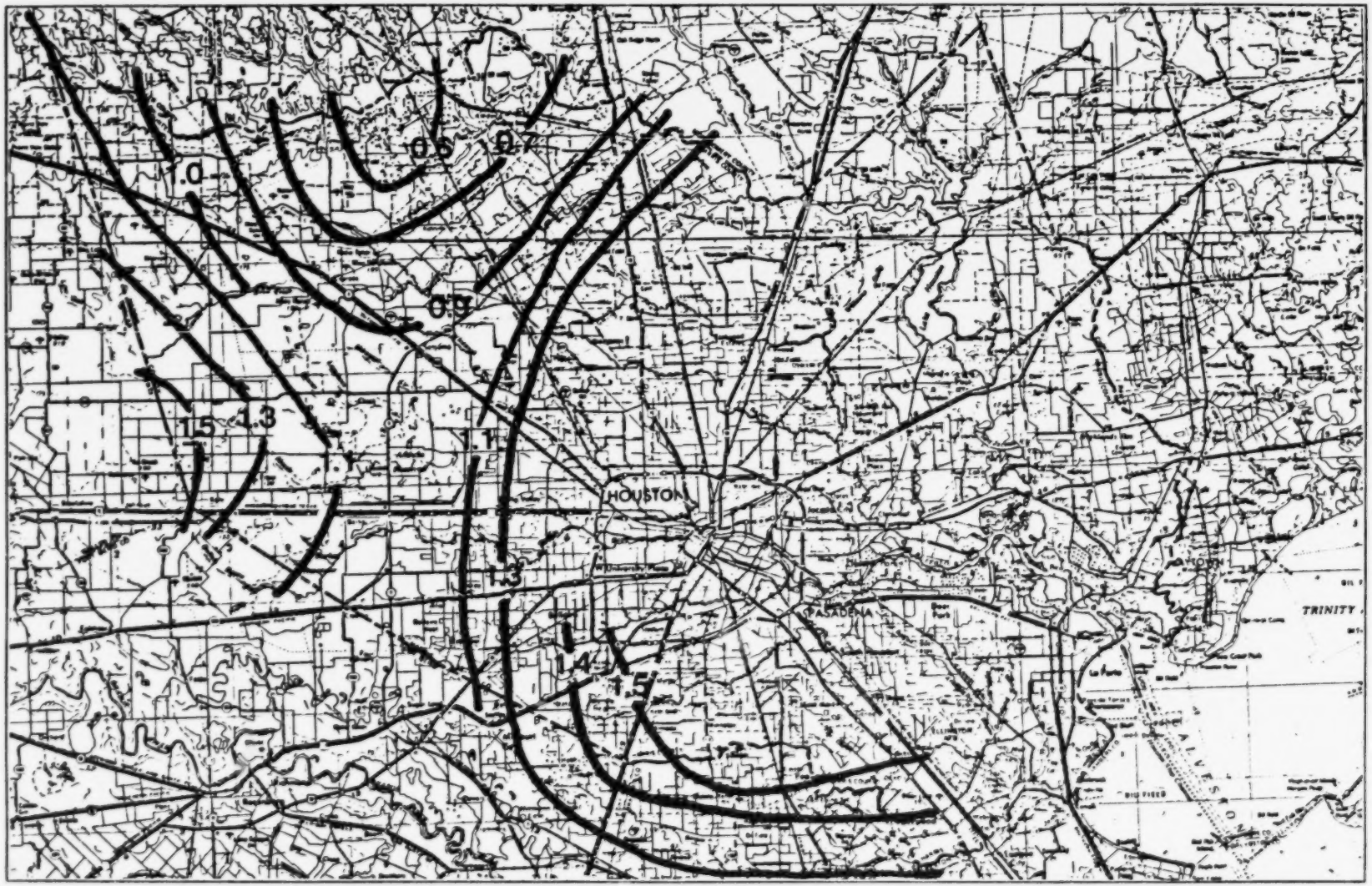


FIGURE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRIS COUNTY, TX
AND INCORPORATED AREAS

APPROXIMATE SCALE

4 0 4 8 12 MILES

MAP COEFFICIENT-C2

The storage-discharge relationships for Spring Creek were obtained from a Flood Plain Information report on Spring Creek (Reference 3.1.9). For the other streams, the storage-discharge relationships were obtained from backwater computations using the HEC-2 computer program (Reference 3.1.6). The rainfall loss rates were set at 1.0 inch initial and 0.05 inch per hour uniform.

HEC-1 Method B

Method B was used for certain streams in the Spring Creek and Lake Houston areas. Rainfall amounts for the 10-, 50-, 100- and 500-year flooding events were determined by relating the drainage areas to percentages of the one percent chance rainfall event taken from the U. S. Weather Bureau Technical Paper No. 40 (Reference 3.1.10). The relationship was determined by analyzing seven gages. Figure 4 shows a plot of the drainage area versus percent of the one-percent rainfall event for related recurrence intervals along with the actual values determined for the seven gages.

For all Method B streams, the 10-, 50-, and 100-year flooding events used an initial loss rate of 1.0 inch and a uniform loss rate of 0.1 inch per hour. The 500-year flooding event used an initial loss rate of 1.0 inch and a uniform loss rate of 0.05 inch per hour. For all Method B streams, unit hydrograph coefficients were determined as stated in Method A. Storage-discharge relationships were determined using the HEC-2 computer program (Reference 3.1.6).

QUIKII

QUIKII is a computer model, developed by the Southwestern Division of the COE, that was used to determine peak discharges at various locations (Reference 3.1.11). The use of QUIKII involves subdividing a portion of the watershed into a number of sub-areas fitting two standard sub-area shapes, and then entering into QUIKII the drainage area, sub-area length, overland flow velocity, valley slope, rainfall amount, and loss rates for each sub-area. Also, a known sub-area storage-discharge relationship can be entered into the program or QUIKII can be allowed to develop a sub-area storage-discharge relationship based on Manning's equation, a typical valley cross section, and the stream length. QUIKII then applies the rainfall, subtracts the losses, and obtains a hydrograph for each sub-area. This hydrograph is then logged, routed, and combined with the other sub-area hydrographs to form a single hydrograph that reveals a peak discharge at the desired location.

Different assumptions were made in applying the QUIKII model for different streams and are described in the following paragraphs. To simplify the presentation of these methodologies, they have been designated as QUIKII Methods A and B.

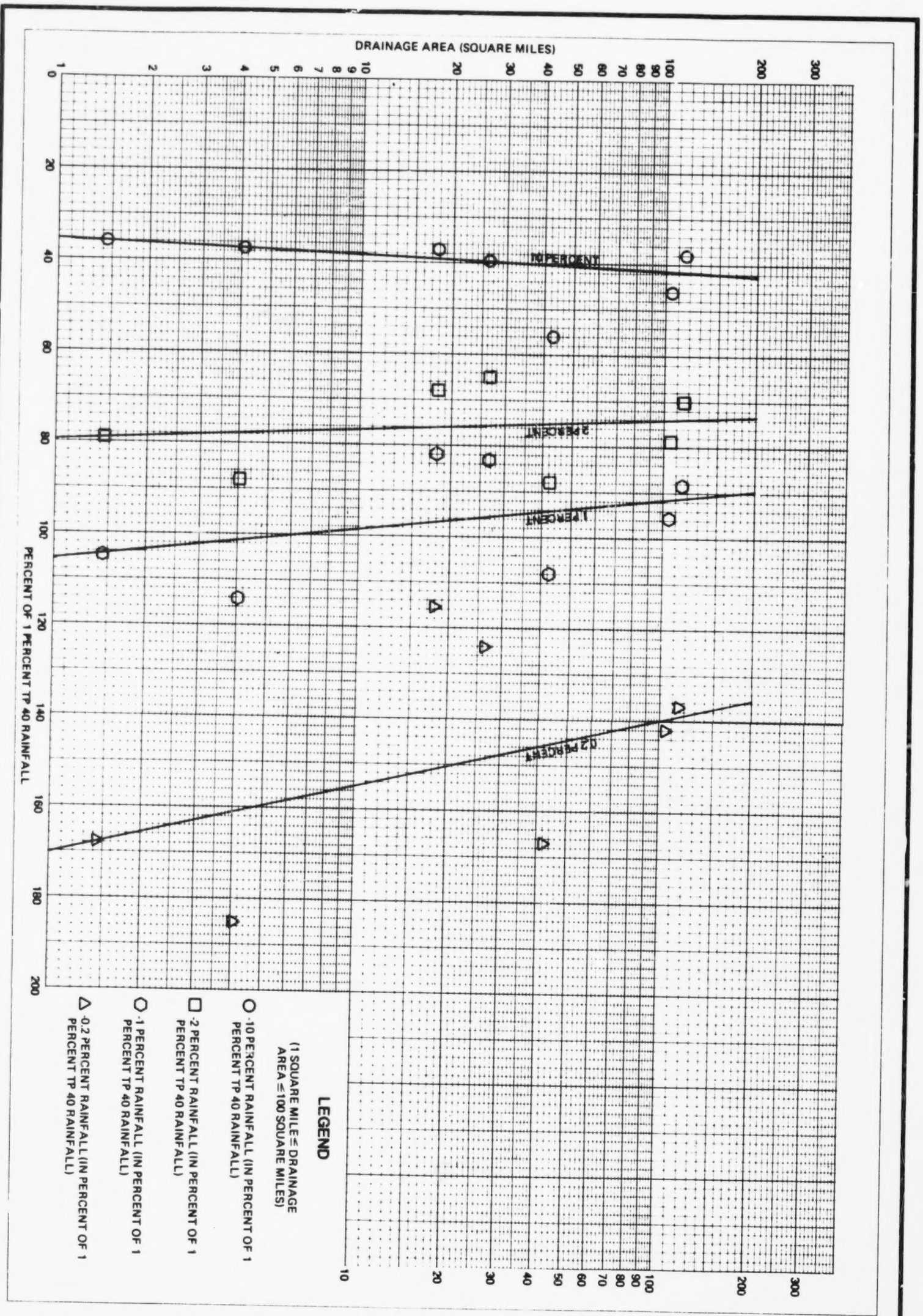


FIGURE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRIS COUNTY, TX AND INCORPORATED AREAS

DRAINAGE AREA VS PERCENT OF THE 1 PERCENT TP 40 RAINFALL

QUIKII Method A

QUIKII Method A was used exclusively for the development of discharges downstream of Lake Houston on the lower San Jacinto River. The input data were developed from USGS topographic maps (Reference 3.1.12). The storage-discharge data were generated by QUIKII. Rainfall loss rates for the lower San Jacinto River were set at 1.0 inch initial and 0.05 inch per hour uniform for the 10-, 50-, 100- and 500-year flooding events. In other areas, rainfall losses for the 10-, 50- and 100-year events were set at 1.0 inch initial and 0.1 inch per hour uniform. The rainfall amount was determined from a regression analysis that related the 10-, 50-, 100- and 500-year events to the PMS index. The equations developed for each exceedence frequency are as follows:

$$\text{10-year rainfall} = (\text{PMS})\,(0.00485)\,(\text{DA}^{0.2933})\,(\text{EL}^{1.1832})\,(1/100)$$
$$\text{50-year rainfall} = (\text{PMS})\,(0.0093)\,(\text{DA}^{0.2644})\,(\text{EL}^{1.2013})\,(1/100)$$
$$\text{100-year rainfall} = (\text{PMS})\,(0.0357)\,(\text{DA}^{0.2247})\,(\text{EL}^{1.03075})\,(1/100)$$
$$\text{500-year rainfall} = (\text{PMS})\,(0.8284)\,(\text{DA}^{0.1426})\,(\text{EL}^{0.6075})\,(1/100)$$

where PMS is probable maximum storm, in inches; DA is drainage area, in square miles; and EL is the mean basin elevation, in feet.

QUIKII Method B

QUIKII Method B was used for some of the tributaries to Lake Houston. QUIKII developed sub-area storage discharge relationships. The input data were developed from USGS topographic maps (Reference 3.1.12). For the 10-, 50-, and 100-year recurrence intervals, rainfall loss rates were set at 1.0 inch and 0.10 inch per hour uniform. For the 500-year event, loss rates were set to 1.0 inch initial and 0.05 inch per hour uniform. Rainfall amounts for the 10-, 50-, 100- and 500-year floods were determined by relating the drainage area with percentages of the one-percent rainfall event as calculated in Technical Paper No. 40 (Reference 3.1.10). This relationship was determined by analyzing seven gages. Figure 4 shows a plot of the drainage area versus percent of the Technical Paper No. 40 one-percent rainfall event for the selected recurrence intervals along the actual values determined for the seven gages.

Rational Equation

The Rational Equation was used to predict peak discharges for flooding sources that have small drainage areas. The Rational Formula is as follows:

$$Q = CIA$$

where Q is the peak discharge, in cfs; C is the runoff coefficient;

I is the uniform rate of rainfall intensity, in inches per hour; and A is the drainage area, in acres.

Values of C were obtained from a table published by the Texas Highway Department (Reference 3.1.13). The rainfall intensity (I) was calculated using the following formulas:

$$I = \text{Precipitation}/T_c$$

$$T_c = L^{1.15}/(7{,}700H^{0.38})$$

where T_c is the estimated time of concentration, in hours; L is the length of watershed along the main stream from the watershed outlet to the most distant ridge, in feet; and H is the difference in elevation between the watershed outlet and the most distant ridge, in feet.

Precipitation was obtained from one-percent Technical Paper No. 40 computations. This method was used in QUIKII for small areas and durations approximately equal to T_c values (Reference 3.1.10).

Table 2, "Summary of Hydrologic Methods" lists all the streams studied by detailed methods along with the previously described method used to study each one.

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
		Clear Creek Watershed	
Clear Creek	A100-00-00	Galveston Bay	HCFCD
Taylor Bayou	A104-00-00	Clear Creek	HCFCD
Tributary 3.10 to Taylor Bayou	A104-04-00	Taylor Bayou	HCFCD
Tributary 3.36 to Taylor Bayou	A104-13-00	Taylor Bayou	HCFCD
Tributary 3.93 to Taylor Bayou	A104-07-00	Taylor Bayou	HCFCD
Cow Bayou	A107-00-00	Clear Creek	HCFCD
Tributary 10.08 to Clear Creek	A111-00-00	Clear Creek	HCFCD
Cedar Gully	A118-00-00	Clear Creek	HCFCD
Turkey Creek	A119-00-00	Clear Creek	HCFCD

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
		Clear Creek Watershed - continued	
Tributary 0.16 to Turkey Creek	A119-02-00	Turkey Creek	HCFCD
Halls Road Ditch	A120-00-00	Clear Creek	HCFCD
Armand Bayou	B100-00-00	Clear Creek	HCFCD
Horsepen Bayou	B104-00-00	Armand Bayou	HCFCD
Tributary 4.51 to Horsepen Bayou	B104-04-00	Horsepen Bayou	HCFCD
Tributary 5.44 to Horsepen Bayou	B104-05-00	Horsepen Bayou	HCFCD
Big Island Slough	B106-00-00	Armand Bayou	HCFCD
Spring Gully	B109-00-00	Armand Bayou	HCFCD
Tributary 9.39 to Armand Bayou	B111-00-00	Armand Bayou	HCFCD
Willow Springs Bayou	B112-00-00	Armand Bayou	HCFCD
Tributary 1.78 to Willow Springs Bayou	B112-02-00	Willow Springs Bayou	HCFCD
Tributary B to Willow Springs Bayou	----------	Willow Springs Bayou	COE T-Year Equations
Tributary 10.46 to Armand Bayou	B113-00-00	Armand Bayou	HCFCD
Tributary 12.18 to Armand Bayou	B115-00-00	Armand Bayou	HCFCD
		San Jacinto River Watershed	
San Jacinto River	G103-00-00	Galveston Bay	COE QUIKII Method A
Lake Houston	G103-00-00	San Jacinto River	COE HEC-1 Method A
Goose Creek	O100-00-00	San Jacinto River	HCFCD
East Fork Goose Creek	O105-00-00	Goose Creek	HCFCD
Spring Gully	O200-00-00	San Jacinto River	HCFCD
Jackson Bayou	R100-00-00	San Jacinto River	HCFCD
Gum Gully	R102-00-00	Jackson Bayou	HCFCD

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
	San Jacinto River Watershed - continued		
Tributary 2.70 to Gum Gully	R102-03-00	Gum Gully	HCFCD
Tributary 3.08 to Gum Gully	R102-13-00	Gum Gully	HCFCD
West Fork San Jacinto River	G103-00-00	Lake Houston	COE HEC-1 Method A
Bens Branch	G103-33-00	West Fork San Jacinto River	HCFCD
Jordan Gully	G103-43-00	West Fork San Jacinto River	HCFCD
Tributary 16.8 to West Fork San Jacinto River	----------	West Fork San Jacinto River	COE QUIKII Method B
Tributary 17.7 to West Fork San Jacinto River	----------	West Fork San Jacinto River	COE QUIKII Method B
East Fork San Jacinto River	G103-80-00	Lake Houston	COE HEC-1 Method A
Luce Bayou	S100-00-00	East Fork San Jacinto River	COE HEC-1 Method A
Shook Gully	S110-00-00	Luce Bayou	COE QUIKII Method B
Mexican Gully	S114-00-00	Luce Bayou	COE QUIKII Method B
Caney Creek	G103-80-03	East Fork San Jacinto River	COE HEC-1 Method A
White Oak Creek	G103-80-03.2	Caney Creek	COE HEC-1 Method B
Taylor Gully	G103-80-03.1	Caney Creek	HCFCD
Mills Branch	G103-80-03.2A	White Oak Creek	HCFCD

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
		Buffalo Bayou Watershed	
Buffalo Bayou from mile 0.00 to mile 15.27	W100-00-00	San Jacinto River	COE HEC-1 Method A
from mile 15.27 to mile 47.52			HCFCD
Patrick Bayou	G104-00-00	Buffalo Bayou	COE T-Year Equations
East 13th Street Outfall Channel	----------	Patrick Bayou	COE T-Year Equations
Glenmore Ditch	G108-00-00	Buffalo Bayou	HCFCD
Carpenters Bayou	N100-00-00	Buffalo Bayou	HCFCD
Tributary 3.33 to Carpenters Bayou	N104-00-00	Carpenters Bayou	HCFCD
Tributary 11.715 to Carpenters Bayou	N117-00-00	Carpenters Bayou	HCFCD
Tributary 6.77 to Buffalo Bayou	----------	Buffalo Bayou	COE T-Year Equations
Hunting Bayou	H100-00-00	Buffalo Bayou	HCFCD
Tributary 5.22 to Hunting Bayou	H103-00-00	Hunting Bayou	HCFCD
Tributary 12.05 to Hunting Bayou	H118-00-00	Hunting Bayou	HCFCD
Tributary 12.70 to Hunting Bayou	H110-00-00	Hunting Bayou	HCFCD
Tributary 13.85 to Hunting Bayou	H112-00-00	Hunting Bayou	COE T-Year Equations
Tributary 8.17 to Buffalo Bayou	----------	Buffalo Bayou	COE T-Year Equations
Vince Bayou	I100-00-00	Buffalo Bayou	HCFCD
Little Vince Bayou	I101-00-00	Vince Bayou	HCFCD
Panther Creek	G112-00-00	Buffalo Bayou	HCFCD

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
		Buffalo Bayou Watershed - continued	
Spring Branch	W140-00-00	Buffalo Bayou	HCFCD
Briar Branch	W140-01-00	Spring Bayou	COE T-Year Equations
Bering Ditch	W142-00-00	Buffalo Bayou	HCFCD
Rummel Creek	W156-00-00	Buffalo Bayou	COE T-Year Equations
Turkey Creek	W167-00-00	Buffalo Bayou	HCFCD
Tributary 3.9 to Turkey Creek	W167-01-00	Turkey Creek	HCFCD
Langham Creek	U100-00-00	Buffalo Bayou	HCFCD
Addicks Reservoir Diversion Channel	----------	Langham Creek	HCFCD
South Mayde Creek	U101-00-00	Langham Creek	HCFCD
Tributary 9.4 to South Mayde Creek	U101-07-01	South Mayde Creek	HCFCD
Bear Creek	U102-00-00	Langham Creek	HCFCD
Horsepen Creek	U106-00-00	Langham Creek	HCFCD
Dinner Creek	U120-00-00	Langham Creek	HCFCD
Clodine Ditch	----------	Buffalo Bayou	COE HEC-1 Method A
Cane Island Branch	T100-00-00	Buffalo Bayou	COE HEC-1 Method A
Mason Creek	T101-00-00	Buffalo Bayou	HCFCD
Tributary 4.96 to Mason Creek	T101-03-00	Mason Creek	HCFCD
Tributary 52.9 to Buffalo Bayou	T103-00-00	Buffalo Bayou	HCFCD
Tributary 2.17 to Tributary 52.9 to Buffalo Bayou	T103-01-00	Tributary 52.9 to Buffalo Bayou	HCFCD
		Greens and Halls Bayous Watersheds	
Greens Bayou	P100-00-00	Buffalo Bayou	HCFCD
Big Gulch	P107-00-00	Greens Bayou	HCFCD
Sulphur Gully	P109-00-00	Greens Bayou	HCFCD

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
	Greens and Halls Bayous Watersheds		
Spring Gully	P110-00-00	Greens Bayou	HCFCD
Halls Bayou	P118-00-00	Greens Bayou	HCFCD
Tributary 6.71 to Halls Bayou	P118-14-00	Halls Bayou	HCFCD
Tributary 11.96 to Halls Bayou	P118-23-00	Halls Bayou	HCFCD
Tributary 14.27 to Greens Bayou	P125-00-00	Greens Bayou	HCFCD
Tributary 14.82 to Greens Bayou	P126-00-00	Greens Bayou	HCFCD
Garners Bayou	P130-00-00	Greens Bayou	HCFCD
Williams Gully	P130-02-00	Garners Bayou	HCFCD
Tributary 2.01 to Williams Gully	P130-02-02	Williams Gully	HCFCD
Tributary 3.19 to Garners Bayou	P130-03-00	Garners Bayou	HCFCD
Tributary 0.55 to Tributary 3.19 to Garners Bayou	P130-03-01	Tributary 3.19 to Garners Bayou	HCFCD
Reinhardt Bayou	P130-05-00	Garners Bayou	HCFCD
Tributary 20.88 to Greens Bayou	P133-00-00	Greens Bayou	HCFCD
Tributary 24.97 to Greens Bayou	P138-00-00	Greens Bayou	HCFCD
Tributary 26.64 to Greens Bayou	P140-00-00	Greens Bayou	HCFCD
P155-00-00	P155-00-00	Greens Bayou	HCFCD
P156-00-00	P156-00-00	Greens Bayou	HCFCD
North Fork Greens Bayou	P145-00-00	Greens Bayou	HCFCD
Tributary 1.95 to North Fork Greens Bayou	P145-03-00	North Fork Greens Bayou	HCFCD
Tributary 32.23 to Greens Bayou	P146-00-00	Greens Bayou	HCFCD
Tributary 34.60 to Greens Bayou	P148-00-00	Greens Bayou	HCFCD

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
	Sims and Brays Bayous Watersheds		
Sims Bayou	C100-00-00	Buffalo Bayou	HCFCD
Plum Creek	C102-00-00	Sims Bayou	HCFCD
Pine Gully	C103-00-00	Sims Bayou	HCFCD
Berry Bayou	C106-00-00	Sims Bayou	HCFCD
Berry Creek	C106-01-00	Berry Bayou	HCFCD
Tributary 2.00 to Berry Bayou	C106-03-00	Berry Bayou	HCFCD
Tributary 3.31 to Berry Bayou	C106-08-00	Berry Bayou	HCFCD
Tributary 10.12 to Sims Bayou	C118-00-00	Sims Bayou	HCFCD
Tributary 10.77 to Sims Bayou	C123-00-00	Sims Bayou	HCFCD
Tributary 13.83 to Sims Bayou	C132-00-00	Sims Bayou	HCFCD
Tributary 17.82 to Sims Bayou	C161-00-00	Sims Bayou	HCFCD
Tributary 20.25 to Sims Bayou	C147-00-00	Sims Bayou	HCFCD
Brays Bayou	D100-00-00	Buffalo Bayou	HCFCD
Willow Waterhole Bayou	D112-00-00	Brays Bayou	HCFCD
Chimney Rock Diversion Channel	D139-00-00	Brays Bayou	HCFCD
Tributary 17.42 to Brays Bayou	D133-00-00	Brays Bayou	HCFCD
Fondren Diversion Channel	D140-00-00	Brays Bayou	HCFCD
Keegans Bayou	D118-00-00	Brays Bayou	HCFCD
Tributary 19.77 to Brays Bayou	----------	Brays Bayou	HCFCD
Tributary 20.86 to Brays Bayou	D142-00-00	Brays Bayou	HCFCD
Tributary 20.90 to Brays Bayou	D120-00-00	Brays Bayou	HCFCD
Tributary 21.95 to Brays Bayou	D122-00-00	Brays Bayou	HCFCD
Tributary 22.69 to Brays Bayou	D124-00-00	Brays Bayou	HCFCD

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
		Sims and Brays Bayous Watersheds - continued	
Tributary 23.53 to Brays Bayou	D126-00-00	Brays Bayou	HCFCD
Tributary 26.20 to Brays Bayou	D129-00-00	Brays Bayou	HCFCD
Tributary 29.16 to Brays Bayou	D132-00-00	Brays Bayou	HCFCD
		White Oak Bayou Watershed	
White Oak Bayou	E100-00-00	Buffalo Bayou	HCFCD
Little White Oak Bayou	E101-00-00	White Oak Bayou	HCFCD
Brickhouse Gully	E115-00-00	White Oak Bayou	HCFCD
Tributary 1.61 to Brickhouse Gully	E115-04-00	Brickhouse Gully	HCFCD
Tributary 10.1 to White Oak Bayou	E116-05-00	White Oak Bayou	HCFCD
Cole Creek	E117-00-00	White Oak Bayou	HCFCD
Vogel Creek	E121-00-00	White Oak Bayou	HCFCD
Tributary 15.8 to White Oak Bayou	E124-00-00	White Oak Bayou	HCFCD
Rolling Fork	E125-00-00	White Oak Bayou	HCFCD
Tributary 19.05 to White Oak Bayou	E127-00-00	White Oak Bayou	HCFCD
Tributary 19.82 to White Oak Bayou	E135-00-00	White Oak Bayou	HCFCD
		Spring and Cypress Creeks Watersheds	
Spring Creek	J100-00-00	West Fork San Jacinto River	COE HEC-1
Bender Lake	----------	Spring Creek	COE QUIKII Method B
Tributary 21.08 to Spring Creek	J121-00-00	Spring Creek	COE QUIKII Method B
Willow Creek	M100-00-00	Spring Creek	HCFCD
Tributary 0.26 to Willow Creek	M101-00-00	Willow Creek	HCFCD
Tributary 2.44 to Willow Creek	M104-00-00	Willow Creek	HCFCD
Hughes Gully	M108-00-00	Willow Creek	HCFCD
Cannon Gully	M109-00-00	Willow Creek	HCFCD
Metzler Creek	M109-01-00	Cannon Gully	HCFCD

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
	Spring and Cypress Creeks Watersheds - continued		
Tributary 6.52 to Willow Creek	M112-00-00	Willow Creek	HCFCD
Tributary 8.16 to Willow Creek	M116-00-00	Willow Creek	HCFCD
Tributary 13.50 to Willow Creek	M124-00-00	Willow Creek	HCFCD
Boggs Gully	J131-00-00	Spring Creek	COE QUIKII Method B
Tributary 1.25 to Boggs Gully	----------	Boggs Gully	COE Rational Formula
Cypress Creek	K100-00-00	Spring Creek	HCFCD
Turkey Creek	K111-00-00	Cypress Creek	HCFCD
Wild Cow Gulch	K112-00-00	Cypress Creek	HCFCD
Schultz Gully	K116-00-00	Cypress Creek	HCFCD
Lemm Gully	K120-00-00	Cypress Creek	HCFCD
Senger Gully	K120-01-00	Lemm Gully	HCFCD
Wunsche Gully	K120-03-00	Lemm Gully	HCFCD
Seals Gully	K124-00-00	Cypress Creek	HCFCD
Kothman Gully	K124-02-00	Seals Gully	HCFCD
Spring Gully	K131-00-00	Cypress Creek	HCFCD
Theiss Gully	K131-02-00	Spring Gully	HCFCD
Tributary 2.1 to Spring Gully	K131-03-00	Spring Gully	HCFCD
Dry Gully	K133-00-00	Cypress Creek	HCFCD
Pillot Gully	K140-00-00	Cypress Creek	HCFCD
Faulkey Gully	K142-00-00	Cypress Creek	HCFCD
Little Cypress Creek	L100-00-00	Cypress Creek	HCFCD
Tributary 9.36 to Little Cypress Creek	L109-00-00	Little Cypress Creek	HCFCD
Tributary 10.99 to Little Cypress Creek	L112-00-00	Little Cypress Creek	HCFCD
Tributary 13.92 to Little Cypress Creek	L114-00-00	Little Cypress Creek	HCFCD
Tributary 0.12 to Tributary 13.92 to Little Cypress Creek	L114-01-00	Tributary 13.92 to Little Cypress Creek	HCFCD

TABLE 2 - SUMMARY OF HYDROLOGIC METHODS - continued

STREAM NAME	HCFCD DESIGNATION	RECEIVING BODY	HYDROLOGIC METHOD
	Spring and Cypress Creeks Watersheds - continued		
Dry Creek	K145-00-00	Cypress Creek	HCFCD
Tributary 36.6 to Cypress Creek	K150-00-00	Cypress Creek	HCFCD
Tributary 37.1 to Cypress Creek	K152-00-00	Cypress Creek	HCFCD
Channel A to Cypress Creek	K159-00-00	Cypress Creek	HCFCD
Channel D to Channel A to Cypress Creek	K159-01-00	Channel A to Cypress Creek	HCFCD
Tributary 40.7 to Cypress Creek	K155-00-00	Cypress Creek	HCFCD
Tributary 42.7 to Cypress Creek	K157-00-00	Cypress Creek	HCFCD
Rock Hollow	K160-00-00	Cypress Creek	HCFCD
Tributary 1.63 to Rock Hollow	----------	Rock Hollow	HCFCD
Tributary 44.5 to Cypress Creek	----------	Cypress Creek	HCFCD
Mound Creek	K166-00-00	Cypress Creek	HCFCD
Little Mound Creek	----------	Mound Creek	HCFCD
Tributary 7.62 to Mound Creek	----------	Mound Creek	HCFCD
Tributary 8.18 to Mound Creek	----------	Mound Creek	HCFCD
	Cedar Bayou Watershed		
Cedar Bayou	Q100-00-00	Galveston Bay	HCFCD
Pine Gully	Q101-00-00	Cedar Bayou	HCFCD
Diversion Channel	----------	Cedar Bayou	COE
Cary Bayou	Q112-00-00	Cedar Bayou	HCFCD
McCee Gully	Q114-00-00	Cedar Bayou	HCFCD
	Little Cedar Bayou Watershed		
Little Cedar Bayou	F216-00-00	Galveston Bay	HCFCD
	Mustang Bayou Watershed		
Mustang Bayou	----------	Chocolate Bay	Espey, Huston & Associates

A summary of the drainage area-peak discharge relationships of the streams studied by detailed methods is shown in Table 3, "Summary of Discharges." Discharges have been adjusted where necessary to reflect overflow. Basin overflow occurs when the water-surface elevations of a flooding source exceed the elevations of the drainage basin divide. This results in part of the discharge leaving the basin, which may result in decreasing discharges further downstream.

TABLE 3 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CLEAR CREEK					
At confluence of Forrest Lake	174.6	14,140	19,290	21,910	33,600
At stream mile 6.24	171.12	10,700	16,300	19,000	24,900
At stream mile 10.21	156.04	10,300	15,300	18,000	23,600
At stream mile 14.45	146.35	9,780	14,300	16,800	22,000
At stream mile 17.72	104.08	6,650	9,900	11,500	15,100
At stream mile 19.85	101.75	6,480	9,900	11,300	14,800
At stream mile 23.08	79.65	4,950	7,360	8,640	11,300
At stream mile 24.67	56.48	3,320	4,780	5,560	7,290
At stream mile 34.47	45.10	2,950	4,220	4,840	6,340
At stream mile 38.25	32.12	1,970	3,200	4,030	6,000
At stream mile 42.33	21.72	1,450	2,450	3,060	4,500
At stream mile 45.90	6.25	630	1,110	1,400	2,150
TAYLOR BAYOU					
At stream mile 0.00	16.18	2,480	3,520	4,070	5,300
At stream mile 3.97	3.03	660	925	1,050	1,320
TRIBUTARY 3.10 TO TAYLOR BAYOU					
At stream mile 0.00	2.08	865	1,190	1,330	1,650
TRIBUTARY 3.36 TO TAYLOR BAYOU					
At stream mile 0.00	4.42	1,290	1,790	2,020	2,580
TRIBUTARY 3.93 TO TAYLOR BAYOU					
At stream mile 0.00	2.23	575	805	910	1,160
COW BAYOU					
At stream mile 0.10	3.99	3,200	4,230	4,650	5,700
At stream mile 2.13	1.00	400	1,450	1,600	1,900

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 10.08 TO CLEAR CREEK					
At stream mile 0.00	4.45	660	1,090	1,320	1,900
CEDAR GULLY*					
At stream mile 0.08	1.08	580	790	880	1,100
TURKEY CREEK* (A119-00-00)					
At stream mile 0.04	9.43	1,770	2,880	3,480	4,950
At stream mile 0.29	8.18	1,510	2,470	3,000	4,300
At stream mile 2.75	3.57	850	1,450	1,800	2,670
TRIBUTARY 0.16 TO TURKEY CREEK					
At stream mile 0.00	1.23	380	610	700	1,000
HALLS ROAD DITCH*					
At stream mile 0.00	8.85	2,890	3,930	4,410	5,500
ARMAND BAYOU					
At confluence with Clear Creek (Clear Lake)	61.74	15,780	20,690	23,300	28,900
At confluence of Horsepen Bayou	37.86	9,760	12,650	14,340	17,100
At confluence of Big Island Slough	27.89	7,190	9,460	10,370	12,600
At confluence of Spring Gully	21.50	6,070	7,950	8,780	10,500
At confluence of Willow Springs Bayou	10.87	3,220	4,360	4,940	6,150
HORSEPEN BAYOU					
At confluence with Armand Bayou	19.28	7,200	10,000	11,000	14,200
At stream mile 2.40	16.18	5,950	8,150	9,000	11,500
At stream mile 3.98	11.71	2,900	4,100	4,600	5,900
At stream mile 4.37	7.63	2,950	4,080	4,550	5,800
TRIBUTARY 4.51 TO HORSEPEN BAYOU					
At stream mile 0.00	4.84	560	860	1,010	1,380

*Discharges adjusted to reflect basin overflow

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 5.44 TO HORSEPEN BAYOU					
At stream mile 0.00	2.95	1,170	1,550	1,760	2,180
BIG ISLAND SLOUGH					
At stream mile 0.00	8.75	3,280	4,530	4,920	6,100
At stream mile 4.95	3.60	1,540	2,110	2,360	2,950
SPRING GULLY (B109-00-00)					
At stream mile 0.00	3.28	1,350	1,850	2,070	2,600
TRIBUTARY 9.39 TO ARMAND BAYOU					
At stream mile 0.00	1.10	620	830	920	1,150
WILLOW SPRINGS BAYOU					
At stream mile 0.00	7.14	2,890	3,810	3,950	4,650
At confluence of Tributary 1.78 to Willow Springs Bayou	2.85	1,650	2,210	2,450	3,000
TRIBUTARY 1.78 TO WILLOW SPRINGS BAYOU					
At confluence with Willow Springs Bayou	2.76	800	1,120	1,260	1,590
TRIBUTARY B TO WILLOW SPRINGS BAYOU					
At confluence with Willow Springs Bayou	0.734	449	736	895	1,309
TRIBUTARY 10.46 TO ARMAND BAYOU					
At confluence with Armand Bayou	3.17	895	1,250	1,410	1,780
TRIBUTARY 12.18 TO ARMAND BAYOU					
At confluence with Armand Bayou	3.43	1,750	2,310	2,570	3,160

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SAN JACINTO RIVER					
At stream mile 8.98	2,896.8	83,000	181,000	252,000	419,000
At stream mile 11.28	2,890.5	83,000	181,000	252,000	420,000
At stream mile 24.50	2,864.8	85,000	183,000	254,000	422,000
At stream mile 28.89	2,828.0	82,400	182,200	246,100	409,900
GOOSE CREEK					
At stream mile 0.00	27.58	9,610	13,490	15,020	19,500
At stream mile 3.78	22.01	8,330	10,870	11,980	15,550
At stream mile 3.95	17.25	6,340	8,240	9,040	11,740
At stream mile 5.95	13.69	4,780	6,100	6,630	8,610
At stream mile 7.13	9.29	3,150	4,170	4,590	5,960
At stream mile 8.14	6.51	2,410	3,300	3,620	4,700
At stream mile 9.07	3.04	1,175	1,630	1,870	2,430
At stream mile 9.10	1.48	570	775	865	1,120
EAST FORK GOOSE CREEK					
At stream mile 0.00	4.76	2,210	3,000	3,340	4,200
At stream mile 0.73	*	1,800	2,450	2,700	3,500
At stream mile 0.75	*	1,180	1,600	1,850	2,300
At stream mile 1.60	2.11	870	1,200	1,350	1,700
At stream mile 2.35	1.17	630	860	950	1,230
SPRING GULLY (0200-00-00)					
At stream mile 0.03	4.84	2,530	3,220	3,530	4,700
At stream mile 0.67	4.32	2,150	2,850	3,100	4,000
At stream mile 1.10	3.68	1,700	2,260	2,450	3,100
At stream mile 1.26	3.10	1,350	1,750	1,900	2,430
At stream mile 2.39	2.24	840	1,120	1,250	1,630
At stream mile 3.13	1.34	515	690	770	1,000
At stream mile 3.82	0.72	340	455	478	630
JACKSON BAYOU					
At stream mile 0.00	24.60	7,300	10,600	12,300	16,400
At confluence of Gum Gully	21.56	6,410	9,490	11,000	14,700
At stream mile 2.37	1.77	1,100	1,610	1,850	2,500

*Data not available

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
GUM GULLY					
At stream mile 0.00	17.82	5,020	7,490	8,640	11,500
At confluence of Tributary 2.70	16.12	4,270	6,370	7,370	9,900
At confluence of Tributary 3.08	10.34	3,360	4,950	5,600	7,480
At stream mile 4.92	8.73	1,670	2,610	3,090	4,300
At stream mile 5.61	6.37	1,050	1,670	2,020	2,850
At stream mile 7.09	2.60	530	860	1,040	1,490
TRIBUTARY 2.70 TO GUM GULLY					
At stream mile 0.00	3.78	950	1,500	1,780	2,450
TRIBUTARY 3.08 TO GUM GULLY					
At stream mile 0.00	2.00	1,280	1,720	1,910	2,400
At stream mile 1.20	0.89	470	630	700	860
WEST FORK SAN JACINTO RIVER					
At stream mile 3.615	1,769.0	66,800	143,000	174,000	333,600
At stream mile 11.58	1,141.0	62,300	127,200	167,500	306,900
BENS BRANCH					
At stream mile 0.00	17.42	2,680	3,660	4,070	5,100
At Tree Lane Court	13.91	1,610	2,500	2,920	4,000
Downstream of Kingwood Diversion Channel	12.28	1,330	2,010	2,320	3,070
JORDAN GULLY					
At stream mile 0.00	2.03	1,100	1,500	1,720	2,190
At corporate limits of the City of Humble	0.92	795	1,120	1,270	1,640
TRIBUTARY 16.8 TO THE WEST FORK SAN JACINTO RIVER					
At stream mile 0.00	1.31	540	1,370	1,830	3,000
TRIBUTARY 17.7 TO THE WEST FORK SAN JACINTO RIVER					
At stream mile 0.00	2.83	610	1,500	2,080	3,430
Upstream of U. S. Route 59	2.63	450	1,120	1,540	2,560
Downstream of Cantertrot Way	1.60	340	870	1,180	2,000

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
EAST FORK SAN JACINTO RIVER					
At stream mile 9.70	1,002.0	41,400	85,200	109,500	185,00
Downstream of confluence of Caney Creek	766.0	41,300	84,400	108,500	182,800
Upstream of confluence of Caney Creek	396.0	11,000	25,500	35,200	66,600
At stream mile 19.78	384.0	10,500	24,500	34,200	66,100
LUCE BAYOU					
At stream mile 0.00	227.0	4,050	10,100	16,100	37,400
At stream mile 7.50	210.0	4,840	12,200	17,200	40,500
SHOOK GULLY					
At stream mile 0.00	1.91	890	2,250	2,940	4,500
MEXICAN GULLY					
At stream mile 0.00	1.27	350	860	1,150	1,950
CANEY CREEK					
At stream mile 0.00	370.0	22,200	52,000	72,400	133,000
WHITE OAK CREEK*					
At stream mile 0.00	29.49	1,900	3,480	4,230	6,080
At stream mile 1.80	24.74	2,370	5,450	7,260	12,600
TAYLOR GULLY					
At stream mile 0.19	**	1,330	1,830	2,070	2,620
At stream mile 2.46	**	720	990	1,110	1,380
MILLS BRANCH*					
At stream mile 1.58	0.87	490	670	750	950
BUFFALO BAYOU					
At 69th Street	211.53	46,600	61,300	66,500	75,000
Upstream of confluence of White Oak Bayou	89.03	16,300	21,800	24,500	29,500
Upstream of confluence of Spring Branch	56.44	12,900	17,000	19,000	22,800
Downstream of confluence of Rummel Creek	**	11,000	13,900	16,500	19,800
At Dairy Ashford Road	**	6,800	8,400	9,400	11,500
Upstream of confluence of Turkey Creek	17.41	2,730	3,690	4,120	5,150

*Discharges adjusted to reflect basin overflow
**Data not available

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
PATRICK BAYOU					
At stream mile 0.00	4.09	3,400	5,400	6,100	7,600
EAST 13TH STREET OUTFALL CHANNEL					
At confluence with Patrick Bayou	1.06	120	220	315	620
At stream mile 1.15/ 13th Street Bridge	0.531	73	135	190	400
GLENMORE DITCH					
At stream mile 0.00	3.27	1,370	2,240	2,660	3,760
At stream mile 1.09	2.79	1,180	1,910	2,280	3,230
At stream mile 2.33	1.84	840	1,380	1,620	2,300
CARPENTERS BAYOU					
At stream mile 0.00	41.49	7,530	10,700	12,230	15,950
Upstream of confluence of Tributary 3.33	34.92	5,470	7,640	8,700	11,200
At stream mile 11.712	19.80	750	1,120	1,460	1,900
TRIBUTARY 3.33 TO CARPENTERS BAYOU					
At stream mile 0.00	3.04	1,280	1,860	2,110	2,760
At Interstate Route 10	2.04	980	1,330	1,510	1,900
At Woodforest Drive	1.43	265	440	535	780
TRIBUTARY 11.715 TO CARPENTERS BAYOU					
At stream mile 0.00	3.00	685	985	1,140	1,500
At stream mile 1.21	1.69	595	840	950	1,210
At stream mile 1.63	0.82	425	580	650	810
TRIBUTARY 6.77 TO BUFFALO BAYOU					
At stream mile 0.00	1.34	250	430	560	1,020
HUNTING BAYOU					
At stream mile 0.00	29.35	5,800	7,700	8,850	11,100
Downstream of H125-00-00	18.99	4,050	5,100	5,600	6,580
At Interstate Route 610	15.27	3,350	4,200	4,650	5,510
Downstream of Tributary 12.05 to Hunting Bayou	9.53	2,350	3,000	3,350	4,000
Downstream of Tributary 12.70 to Hunting Bayou	4.69	1,700	2,100	2,300	2,650

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
HUNTING BAYOU (continued)					
At Southern Pacific Railroad	1.01	1,000	1,350	1,550	1,900
TRIBUTARY 5.22 TO HUNTING BAYOU					
At stream mile 0.00	2.50	840	1,170	1,340	1,680
At Mercury Drive	1.89	590	820	930	1,160
At stream mile 2.12	1.14	300	410	470	600
At Gellhorn Drive	0.76	180	250	280	370
TRIBUTARY 12.05 TO HUNTING BAYOU*					
At stream mile 0.00	4.40	760	1,040	1,280	1,800
At Wipprecht Road	3.37	570	800	980	1,390
TRIBUTARY 12.70 TO HUNTING BAYOU					
At stream mile 0.00	1.13	390	540	620	780
At Calvacade Street	0.71	220	300	340	430
At Crane Street	0.26	60	80	90	140
TRIBUTARY 13.85 TO HUNTING BAYOU					
At stream mile 0.00	0.96	483	809	993	1,539
TRIBUTARY 8.17 TO BUFFALO BAYOU					
At stream mile 0.00	0.50	75	140	200	510
VINCE BAYOU					
At stream mile 0.00	15.18	9,340	12,100	13,200	16,000
At stream mile 0.540	14.79	9,160	11,800	12,800	15,500
At stream mile 0.541	14.79	6,950	8,650	10,200	12,400
At stream mile 1.58	9.16	6,490	7,680	9,590	11,700
At stream mile 1.77	8.53	6,020	7,130	8,900	10,800
At stream mile 2.23	7.33	5,760	6,130	8,400	10,200
At stream mile 3.15	6.20	4,610	5,610	6,760	8,220
At stream mile 3.74	5.00	3,530	4,160	5,170	6,280
At stream mile 4.38	4.49	3,120	3,480	4,520	5,490
At stream mile 4.82	3.68	2,610	2,960	3,850	4,680
At stream mile 4.83	2.93	2,040	2,740	3,030	3,680
At stream mile 5.92	1.59	1,160	1,530	1,680	2,040

*Discharges adjusted to reflect basin overflow

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LITTLE VINCE BAYOU					
At stream mile 0.00	4.78	2,315	2,760	2,960	3,500
At stream mile 2.38	3.38	1,680	2,020	2,170	2,560
At stream mile 2.42	2.73	1,350	1,630	1,750	2,070
At stream mile 2.87	1.98	1,000	1,210	1,270	1,500
PANTHER CREEK					
At stream mile 0.00	1.46	1,700	2,200	2,400	2,900
SPRING BRANCH					
At stream mile 0.00	10.76	7,350	9,920	11,210	14,000
Upstream of confluence of Briar Branch	7.12	4,610	6,260	7,000	8,800
At Campbell Road	1.75	1,370	1,780	2,050	2,500
BRIAR BRANCH					
At stream mile 1.05	4.41	1,259	1,689	1,865	2,323
BERING DITCH					
At stream mile 0.00	2.94	3,290	4,230	4,690	5,600
At Westheimer Road	1.00	745	970	1,080	1,300
RUMMEL CREEK					
At stream mile 0.00	4.13	1,990	2,660	3,000	3,700
At Interstate Route 10	2.77	1,170	1,580	1,790	2,250
TURKEY CREEK (W167-00-00)					
At stream mile 0.00	7.97	2,600	3,540	3,590	4,680
At Timberline Road	6.12	1,660	2,220	2,600	3,050
TRIBUTARY 3.9 TO TURKEY CREEK					
At stream mile 0.00	2.45	430	550	640	890
At Addicks Reservoir Boundary	1.73	310	410	460	570
At stream mile 3.05	1.17	110	130	130	140
LANGHAM CREEK					
At Clay Road	47.14	7,030	10,860	12,790	17,500
At stream mile 4.69	45.40	690/ 6,050**	1,820/ 8,480**	2,610/ 9,660**	4,630/ 12,080**
At Addicks Satsuma Road	24.03	2,280	3,640	4,520	6,450
At confluence of Dinner Creek	18.82	1,540	2,570	3,260	4,800
At stream mile 13.07	7.34	530	890	1,150	1,700
At stream mile 17.25	1.01	120	215	270	415

**Discharge in natural channel/discharge in Addicks diversion channel

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ADDICKS RESERVOIR DIVERSION CHANNEL					
At stream mile 0.19	**	5,550	7,960	9,200	11,920
SOUTH MAYDE CREEK*					
At Groeschke Road	34.70	3,930	6,200	7,710	11,000
At stream mile 7.22	30.93	3,160	5,310	6,580	9,500
At stream mile 8.58	28.14	2,620	4,320	5,320	7,800
At Morton Ranch Road	25.56	2,290	3,660	4,600	6,650
At Clay Road	20.38	1,930	3,150	3,980	5,840
At stream mile 12.87	14.56	1,430	2,380	3,020	4,550
At Katy-Hockley Road	6.52	669	1,080	1,390	3,830
At stream mile 18.26	1.07	202	332	418	610
TRIBUTARY 9.4 TO SOUTH MAYDE CREEK*					
At stream mile 0.00	4.20	332	461	563	745
At Porter Road	1.95	340	372	680	900
At Katy-Hockley Road	0.88	163	267	336	494
BEAR CREEK*					
At stream mile 3.73	31.34	2,470	4,050	4,860	7,050
At stream mile 5.05	28.74	2,220	3,700	4,470	6,400
At Clay Road	23.87	1,840	3,150	3,810	5,550
At stream mile 12.30	13.84	1,120	2,020	2,420	3,750
At stream mile 16.52	6.88	560	2,300	3,850	6,000
HORSEPEN CREEK*					
At stream mile 0.53	18.36	4,680	6,570	7,700	10,010
At Spencer Highway	17.50	3,840	5,490	6,410	8,400
At FM 1960	13.49	2,510	3,660	4,350	5,840
At stream mile 5.73	6.15	650	1,080	1,360	1,960
DINNER CREEK					
At confluence of Langham Creek	5.25	695	1,130	1,410	2,040
At Freeman Road	..38	350	610	780	1,200
At stream mile 4.00	1.00	52	110	170	280

*Discharges adjusted to reflect basin overflow
**Data not applicable; flow diverted from Langham Creek and Horsepen Creek to Addicks Reservoir

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CLODINE DITCH					
At stream mile 0.00	11.98	964	1,400	1,590	2,020
At stream mile 5.23	11.59	944	1,370	1,550	2,000
At stream mile 6.53	10.53	845	1,230	1,370	1,760
CANE ISLAND BRANCH					
At stream mile 0.0	26.35	3,192	3,794	4,135	4,962
At stream mile 0.9	25.90	3,318	4,498	5,172	6,768
At stream mile 1.2	25.41	3,529	5,874	7,209	10,451
At stream mile 1.9	24.51	3,486	6,140	7,601	11,365
At stream mile 3.1	22.96	3,257	5,529	6,766	10,387
MASON CREEK*					
At stream mile 0.00	18.92	4,810	6,930	8,150	11,200
At stream mile 3.29	14.34	3,450	5,080	5,980	8,220
At stream mile 4.68	9.48	1,890	2,840	3,390	4,660
At stream mile 6.95	4.13	380	660	900	1,650
TRIBUTARY 4.96 TO MASON CREEK					
At stream mile 0.00	2.48	740	1,030	1,180	1,540
TRIBUTARY 52.9 TO BUFFALO BAYOU					
At stream mile 1.27	4.26	1,480	1,990	2,360	3,140
At stream mile 2.29	2.68	720	950	1,080	1,340
TRIBUTARY 2.17 TO TRIBUTARY 52.9 TO BUFFALO BAYOU					
At stream mile 0.00	1.35	370	555	665	905
GREENS BAYOU*					
At stream mile 0.00	196.03	24,200	31,700	35,900	45,000
Upstream of confluence of Tributary 10.85 to Greens Bayou	174.75	22,500	28,800	31,900	40,000
Upstream of confluence of Halls Bayou	137.68	18,920	23,740	25,960	29,990
Upstream of confluence of Garners Bayou	79.11	13,280	16,500	17,820	20,460
At U. S. Route 59	68.44	13,200	15,550	16,910	18,790
At Union Pacific Railroad	45.70	10,720	12,810	13,970	16,670
At Cutten Road	9.51	2,840	3,750	4,190	5,010

*Discharges adjusted to reflect basin overflow

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
BIG GULCH					
At stream mile 0.00	5.19	630	900	1,050	1,400
At Beaumont Highway	1.65	400	580	660	860
SULPHUR GULLY					
At stream mile 0.00	1.43	720	985	1,110	1,390
SPRING GULLY (P110-00-00)					
At stream mile 0.00	1.78	1,050	1,450	1,580	1,950
HALLS BAYOU					
At stream mile 0.24	44.17	7,080	9,450	10,660	13,010
At Union Pacific Railroad	37.44	6,060	7,740	8,600	10,200
At Jenson Drive	27.95	5,090	6,780	7,510	9,200
At Hardy Road	17.71	3,160	4,000	4,600	5,540
At Deertrail Street	10.18	2,370	3,350	3,850	4,980
At Mosielee Street	1.16	740	980	1,100	1,340
TRIBUTARY 6.17 TO HALLS BAYOU					
At stream mile 0.00	2.89	530	730	840	1,060
TRIBUTARY 11.96 TO HALLS BAYOU					
At stream mile 0.00	1.42	1,100	1,440	1,610	1,980
TRIBUTARY 14.27 TO GREENS BAYOU					
At stream mile 0.00	4.25	890	1,260	1,440	1,850
TRIBUTARY 14.82 TO GREENS BAYOU					
At stream mile 0.00	3.01	1,010	1,400	1,590	2,030
GARNERS BAYOU					
At stream mile 0.00	32.63	6,670	8,820	10,060	12,400
Upstream of confluence of Reinhardt Bayou	12.02	2,930	3,940	4,340	5,390
WILLIAMS GULLY					
At stream mile 0.00	7.42	2,400	3,340	3,820	4,900
Upstream of confluence of Tributary 2.01 to Williams Gully	2.60	900	1,250	1,420	1,800
TRIBUTARY 2.01 TO WILLIAMS GULLY					
At stream mile 0.00	2.39	660	920	1,050	1,320

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 3.19 TO GARNERS BAYOU					
At stream mile 0.00	4.10	1,000	1,400	1,600	2,000
TRIBUTARY 0.55 TO TRIBUTARY 3.19 TO GARNERS BAYOU					
At stream mile 0.00	2.09	630	870	980	1,250
REINHARDT BAYOU					
At stream mile 0.00	5.16	1,020	1,450	1,680	2,200
TRIBUTARY 20.88 TO GREENS BAYOU					
At stream mile 0.00	3.77	1,200	1,670	1,910	2,420
At U. S. Route 59	1.00	410	565	640	830
TRIBUTARY 24.97 TO GREENS BAYOU					
At stream mile 0.00	6.04	1,450	2,050	2,350	3,000
At Hardy Road	2.93	690	970	1,130	1,450
TRIBUTARY 26.64 TO GREENS BAYOU*					
At stream mile 0.00	3.77	1,210	1,680	1,930	2,410
P155-00-00					
At stream mile 0.00 (flow diverted from P140-00-00)	**	550	750	850	1,050
P156-00-00					
At stream mile 0.00	3.18	870	1,140	1,270	1,530
NORTH FORK GREENS BAYOU					
At stream mile 0.00	11.12	2,800	3,900	4,500	5,700
Upstream of confluence of Tributary 1.95	5.54	1,200	1,700	1,950	2,600
TRIBUTARY 1.95 TO NORTH FORK GREENS BAYOU					
At stream mile 0.00	2.6	1,205	1,700	1,910	2,500
At stream mile 2.71	1.1	160	210	245	325

*Discharges adjusted to reflect basin overflow
**Data not available

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 32.23 TO GREENS BAYOU					
At stream mile 0.00	1.61	390	550	630	810
At Spears Road	0.55	190	250	290	370
TRIBUTARY 34.60 TO GREENS BAYOU					
At stream mile 0.00	2.01	1,080	1,450	1,640	2,100
SIMS BAYOU					
At stream mile 0.00	93.19	17,800	23,300	26,400	33,200
Downstream of Plum Creek	91.89	17,340	23,020	25,880	32,700
Upstream of Pine Gully	85.01	16,450	21,000	22,910	28,300
Upstream of Berry Bayou	68.55	13,360	15,390	17,410	21,100
At Mykawa Road	57.43	11,530	14,280	15,450	17,900
Upstream of Tributary 10.77	49.56	10,190	12,740	13,550	15,800
Upstream of Tributary 13.83 to Sims Bayou	37.46	7,690	9,690	10,480	12,600
At Hiram-Clarke Road	19.55	5,030	6,630	7,430	8,000
Upstream of Tributary 20.25	7.44	1,830	2,770	3,230	4,700
Upstream of Tributary 22.51	2.67	500	770	900	1,200
At stream mile 23.84	1.00	200	310	370	490
PLUM CREEK					
At stream mile 0.00	3.43	3,330	4,320	4,740	5,700
At Berkley Road	2.23	2,230	2,880	3,159	3,800
At Interstate Route 45	1.52	1,800	2,300	2,550	3,050
PINE GULLY (C103-00-00)					
At stream mile 0.00	1.67	1,850	2,390	2,610	3,100
At stream mile 2.08	1.00	1,080	1,370	1,530	1,820
BERRY BAYOU*					
At stream mile 0.00	17.08	6,640	8,970	9,960	12,100
Upstream of Tributary 2.00 to Berry Bayou	7.43	3,150	4,350	4,900	5,600
Upstream of Spencer Highway	6.69	2,900	4,100	4,600	5,600
Upstream of Tributary 3.31	2.86	1,390	2,000	2,220	2,700
At stream mile 5.89	1.00	770	1,020	1,150	1,400

*Discharges adjusted to reflect basin overflow

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
BERRY CREEK					
At stream mile 0.00	4.90	1,850	2,250	2,810	3,550
Upstream of C106-01-02	3.03	1,080	1,470	1,640	2,050
At stream mile 4.74	1.00	640	750	820	1,000
TRIBUTARY 2.00 TO BERRY BAYOU					
At stream mile 0.00	2.64	990	1,240	1,350	1,600
Upstream of College Avenue	1.24	450	520	540	640
TRIBUTARY 3.31 TO BERRY BAYOU					
At stream mile 0.00	1.72	880	1,190	1,330	1,650
At stream mile 1.07	1.00	630	820	910	1,130
TRIBUTARY 10.12 TO SIMS BAYOU					
At stream mile 0.00	2.48	1,090	1,600	1,850	2,260
At stream mile 1.99	1.00	420	610	700	850
TRIBUTARY 10.77 TO SIMS BAYOU					
At stream mile 0.00	2.54	800	1,200	1,400	1,850
At stream mile 1.635	1.00	310	450	530	700
TRIBUTARY 13.83 TO SIMS BAYOU					
At stream mile 0.00	3.22	970	1,340	1,520	1,880
At State Route 288	1.57	330	510	600	800
At stream mile 1.47	1.00	190	300	360	470
TRIBUTARY 17.82 TO SIMS BAYOU					
At stream mile 0.00	2.06	250	400	490	590
TRIBUTARY 20.25 TO SIMS BAYOU					
At stream mile 0.00	6.58	1,920	2,610	3,000	3,800
Upstream of C147-02-00	2.19	610	920	1,070	1,360
At stream mile 1.57	1.00	280	430	490	620

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
BRAYS BAYOU					
At stream mile 0.00	129.50	39,200	48,900	53,550	63,500
Upstream of Scott Street	112.31	32,990	42,980	45,690	55,000
Upstream of South Braeswood Boulevard	96.48	27,600	37,400	41,490	52,000
Upstream of Braeswood Boulevard	87.41	25,630	34,200	37,510	46,000
At stream mile 19.16	36.38	10,230	13,930	15,650	19,400
At stream mile 21.04	31.33	8,763	11,710	13,140	16,200
At stream mile 24.99	16.62	4,660	5,550	5,830	6,650
At stream mile 26.05	14.51	4,210	5,250	5,650	6,650
At stream mile 28.89	6.64	2,410	3,310	3,770	4,750
WILLOW WATERHOLE BAYOU					
At stream mile 0.00	4.76	3,460	4,540	5,060	6,200
At confluence of Chimney Rock Diversion Channel	1.83	1,560	2,040	2,280	2,750
CHIMNEY ROCK DIVERSION CHANNEL					
At stream mile 0.00	1.36	1,520	2,000	2,240	2,700
TRIBUTARY 17.42 TO BRAYS BAYOU					
At stream mile 0.00	4.53	2,640	3,500	3,940	4,870
FONDREN DIVERSION CHANNEL					
At stream mile 0.00	7.93	2,200	3,000	3,430	4,300
KEEGANS BAYOU					
At stream mile 0.00	17.48	4,520	6,300	7,200	9,020
At Roark Road	12.18	3,080	4,240	4,780	6,500
At Keegans Road	8.18	2,040	2,840	3,300	4,130
TRIBUTARY 19.77 TO BRAYS BAYOU					
At stream mile 0.00	1.33	662	826	932	1,100
TRIBUTARY 20.86 TO BRAYS BAYOU					
At stream mile 0.00	2.18	1,490	1,745	1,929	2,200

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 20.90 TO BRAYS BAYOU					
At stream mile 0.00	3.56	1,532	1,943	2,196	2,550
TRIBUTARY 21.95 TO BRAYS BAYOU					
At stream mile 0.0	4.60	1,977	2,509	2,737	3,250
TRIBUTARY 22.69 TO BRAYS BAYOU					
At stream mile 0.00	2.52	1,099	1,436	1,651	2,020
TRIBUTARY 23.53 TO BRAYS BAYOU					
At stream mile 0.00	1.85	1,051	1,320	1,486	1,750
TRIBUTARY 26.20 TO BRAYS BAYOU					
At stream mile 0.00	4.91	1,950	2,700	3,000	4,000
TRIBUTARY 29.16 TO BRAYS BAYOU					
At stream mile 0.00	4.46	1,735	2,200	2,383	2,720
WHITE OAK BAYOU					
At stream mile 0.01	110.14	28,700	39,700	45,200	62,100
At stream mile 1.48	88.15	21,600	30,100	34,400	47,300
At stream mile 3.48	86.38	21,300	29,600	33,800	46,400
At stream mile 6.82	79.53	19,000	25,000	30,500	41,900
At stream mile 8.91	73.78	16,800	23,700	26,900	37,100
At stream mile 9.21	62.40	12,800	17,600	19,700	27,100
At stream mile 10.67	58.34	11,700	15,400	17,100	23,500
At stream mile 10.73	47.99	9,350	11,900	13,200	18,100
At stream mile 12.06	44.83	8,710	10,700	11,700	16,100
At stream mile 12.36	35.56	6,980	8,490	9,560	13,100
At stream mile 15.90	25.91	6,060	7,920	9,000	12,400
At stream mile 19.09	18.40	4,890	6,490	7,300	9,660
At stream mile 24.45	2.81	1,850	2,460	2,760	3,650
LITTLE WHITE OAK BAYOU					
At stream mile 0.11	20.82	8,680	11,000	11,860	14,100
At stream mile 2.98	15.85	6,340	8,740	9,920	11,800
At stream mile 8.14	1.15	110	150	170	200

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
BRICKHOUSE GULLY*					
At stream mile 0.03	11.36	5,710	7,670	8,650	10,900
At stream mile 3.85	4.56	2,600	3,040	3,340	3,900
At stream mile 6.04	1.05	780	1,015	1,090	1,280
TRIBUTARY 1.61 TO BRICKHOUSE GULLY					
At stream mile 0.04	1.67	840	1,100	1,300	1,760
TRIBUTARY 10.1 TO WHITE OAK BAYOU*					
At stream mile 0.02	1.97	960	1,350	1,540	2,140
COLE CREEK					
At stream mile 0.00	10.35	2,860	3,910	4,370	5,890
At stream mile 1.71	8.49	2,060	2,830	3,220	4,330
At stream mile 4.84	2.54	720	990	1,125	1,470
VOGEL CREEK					
At stream mile 0.00	9.27	3,100	4,250	4,820	5,400
At stream mile 4.44	1.65	690	940	1,060	1,190
At stream mile 5.93	0.69	440	600	660	740
TRIBUTARY 15.8 TO WHITE OAK BAYOU*					
At stream mile 0.10	1.94	563	880	1,065	1,375
At stream mile 2.00	1.34	175	300	370	530
At stream mile 3.07	1.09	151	260	325	475
ROLLING FORK*					
At stream mile 0.01	5.53	478	868	1,103	1,700
At stream mile 2.32	3.42	220	485	610	990

*Discharges adjusted to reflect basin overflow

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 19.05 TO WHITE OAK BAYOU					
At confluence with White Oak Bayou	2.14	690	960	1,100	1,590
Downstream of Interstate Route 290	0.79	370	510	580	810
TRIBUTARY 19.82 TO WHITE OAK BAYOU					
At stream mile 0.09	1.75	630	860	980	1,370
SPRING CREEK					
At stream mile 0.00	760.0	23,700	56,500	75,600	134,000
At stream mile 3.52	438.0	13,900	36,300	51,600	101,000
At stream mile 13.17	422.0	17,600	39,700	52,900	92,300
At stream mile 21.60	365.0	19,300	40,400	51,700	82,700
At stream mile 37.27	192.0	14,400	31,900	42,600	74,700
At stream mile 44.04	182.0	17,100	36,300	47,200	78,700
At stream mile 48.22	97.0	9,200	20,500	27,200	47,200
BENDER LAKE					
At stream mile 0.00	2.78	1,000	2,660	3,540	5,640
TRIBUTARY 21.08 TO SPRING CREEK					
At stream mile 0.00	1.77	690	1,630	2,150	3,600
WILLOW CREEK*					
At stream mile 0.00	54.44	6,480	9,310	11,000	14,600
At stream mile 2.75	48.80	5,980	8,460	9,980	13,100
At stream mile 4.00	45.73	5,740	8,100	9,550	12,700
At stream mile 5.96	38.96	5,060	7,160	8,450	11,200
At stream mile 8.14	33.03	4,660	6,600	7,790	10,200
At stream mile 10.58	27.21	4,220	5,980	7,080	9,370
At stream mile 13.25	19.89	3,580	5,100	6,016	7,990
At stream mile 15.66	12.13	2,790	3,940	4,570	6,080
At stream mile 17.06	5.93	2,170	3,020	3,480	4,630
TRIBUTARY 0.26 TO WILLOW CREEK					
At stream mile 0.00	1.58	680	940	1,070	1,430

*Discharges adjusted to reflect basin overflow

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 2.44 TO WILLOW CREEK					
At stream mile 0.00	2.03	880	1,210	1,390	1,850
At stream mile 1.57	0.98	540	780	865	1,150
HUGHES GULLY					
At stream mile 0.00	1.77	805	1,110	1,260	1,680
At stream mile 0.58	1.07	535	755	850	1,130
CANNON GULLY					
At stream mile 0.00	3.28	2,140	2,890	3,270	4,350
At stream mile 1.10	1.07	780	1,110	1,200	1,600
METZLER CREEK					
At stream mile 0.00	1.30	790	1,100	1,360	1,800
At stream mile 0.69	1.00	555	795	895	1,180
TRIBUTARY 6.52 TO WILLOW CREEK					
At stream mile 0.00	3.82	1,400	1,940	2,230	2,880
At stream mile 1.23	3.03	1,170	1,650	1,880	2,390
At stream mile 1.99	1.53	695	1,010	1,120	1,430
TRIBUTARY 8.16 TO WILLOW CREEK					
At stream mile 0.00	3.24	1,340	1,850	2,120	2,730
At stream mile 1.18	2.25	1,010	1,430	1,610	2,080
At stream mile 2.23	1.06	555	830	920	1,170
TRIBUTARY 13.50 TO WILLOW CREEK*					
At stream mile 0.00	3.81	1,040	1,330	1,530	1,900
At stream mile 1.21	3.28	920	1,160	1,320	1,700
At stream mile 2.51	2.80	910	1,280	1,460	1,900
At stream mile 3.82	1.00	430	650	710	920
BOGGS GULLY					
At stream mile 0.00	4.30	750	1,620	2,150	3,680
Upstream of Tributary 1.25 to Boggs Gully	3.12	550	1,290	1,720	2,920
Upstream of stream mile 2.10 and private road	1.63	420	1,050	1,420	2,490

*Discharges adjusted to reflect basin overflow

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 1.25 TO BOGGS GULLY					
At stream mile 0.00	0.55	200	450	600	960
CYPRESS CREEK*					
At stream mile 0.00	325.8	15,100	20,800	24,400	33,400
At stream mile 1.60	315.4	14,500	20,400	24,000	33,000
At stream mile 3.27	304.6	13,300	18,900	22,500	31,800
At stream mile 6.15	299.9	13,100	18,600	22,300	31,600
At Interstate Route 45	288.5	12,300	18,100	21,900	30,800
At stream mile 10.77	277.9	11,600	17,600	21,400	30,100
At stream mile 15.69	257.8	10,700	16,700	20,300	28,300
At stream mile 18.13	244.0	10,300	16,200	19,800	27,500
At stream mile 21.44	234.2	10,000	15,700	19,200	26,600
At stream mile 23.49	218.9	9,400	14,900	18,200	25,100
At stream mile 27.62	155.2	6,900	9,300	11,100	12,600
At stream mile 32.27	143.9	6,600	8,800	10,500	14,400
At stream mile 35.82	132.8	6,400	8,400	10,000	14,100
At stream mile 39.45	121.8	6,100	8,000	9,600	13,500
At Katy-Hockley Road	91.8	6,200	8,400	10,100	13,500
At stream mile 43.44	85.2	6,500	10,600	13,400	20,200
At stream mile 45.96	81.3	6,900	10,800	13,800	21,000
At stream mile 49.38	48.1	5,500	9,400	12,400	19,800
At stream mile 51.70	35.8	4,400	7,400	9,900	15,800
TURKEY CREEK (K111-00-00)					
At stream mile 0.00	12.4	3,470	4,860	5,610	7,150
At Humble-Westfield Road	11.6	3,290	4,580	5,290	6,710
At Aldine-Westfield Road	7.1	2,290	3,160	3,650	4,500
At Missouri-Pacific Railroad	4.8	1,720	2,370	2,720	3,360
At North Vista Drive	0.9	550	730	820	1,040
WILD COW GULCH					
At stream mile 0.00	3.6	1,940	2,640	3,000	3,810
At Treaschwig Road	2.3	1,460	2,020	2,270	2,860
At Reynaldo Road	1.9	1,260	1,770	1,960	2,460
At stream mile 1.65	1.4	470	800	950	1,170
At Hickory Gate Drive	1.1	160	280	360	430

*Discharges adjusted to reflect basin overflow

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SCHULTZ GULLY					
At stream mile 0.00	2.3	650	900	1,030	1,270
At Woodriver Drive	1.7	280	460	560	680
At stream mile 0.87	1.2	70	160	220	260
LEMM GULLY					
At stream mile 0.00	7.7	1,350	1,890	2,180	2,750
At stream mile 1.77	1.9	980	1,400	1,590	1,990
At stream mile 2.49	1.1	400	620	760	930
At stream mile 3.05	0.4	130	260	350	420
SENGER GULLY					
At stream mile 0.00	3.3	1,130	1,580	1,820	2,280
At Northhill Drive	3.0	1,030	1,460	1,690	2,110
At Cypresswood Road	2.5	870	1,260	1,480	1,840
At Louetta Road	1.1	400	660	800	980
WUNSCHE GULLY					
At stream mile 0.00	1.6	620	920	1,020	1,260
At Spring-Cypress Road	1.1	400	620	760	930
At stream mile 1.92	0.9	320	520	650	790
SEALS GULLY					
At stream mile 0.35	7.3	2,970	4,090	4,690	6,040
At Mirror Lake Road	4.2	1,320	1,840	2,130	2,680
At Louetta Road	3.1	980	1,360	1,580	1,970
At stream mile 3.26	2.6	870	1,200	1,390	1,730
At Castlemont Road	1.0	360	490	560	680
KOTHMAN GULLY					
At stream mile 0.00	2.7	970	1,350	1,550	2,100
At Spring-Cypress Road	1.6	660	1,100	1,180	1,460
At FM 2920	1.1	520	830	1,010	1,240
At Spring-Stuebner Road	0.6	330	560	650	790
SPRING GULLY (K131-00-00)					
At stream mile 0.10	16.2	4,600	6,450	7,460	10,120
At Louetta Road	7.2	1,970	2,760	3,200	3,800
At stream mile 2.95	5.2	1,540	2,190	2,500	3,160
At Spring-Cypress Road	3.1	1,030	1,520	1,700	2,130
At stream mile 4.52	1.0	460	770	970	1,190

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
THEISS GULLY					
At stream mile 0.00	7.9	2,150	3,030	3,500	4,470
At Sir William Road	7.3	2,020	2,870	3,300	4,210
At Louetta Road	6.7	1,890	2,700	3,090	3,940
At Oakwood Glen	5.3	1,580	2,280	2,590	3,280
At Steubner-Airline Road	4.5	1,400	2,030	2,290	2,890
At Theisswood Road	4.3	1,350	1,970	2,220	2,790
At Spring-Cypress Road	3.4	1,130	1,660	1,860	2,330
At stream mile 4.00	1.7	520	870	1,080	1,330
At stream mile 4.83	1.0	330	590	760	930
TRIBUTARY 2.1 TO SPRING GULLY					
At stream mile 0.00	1.2	670	910	1,030	1,270
At stream mile 0.63	0.8	210	390	530	640
At stream mile 1.50	0.4	90	200	300	360
DRY GULLY					
At stream mile 0.00	4.8	2,470	3,370	3,840	4,920
At Champion Forest Drive	4.6	2,000	2,880	3,330	4,250
At Louetta Road	4.1	1,710	2,560	2,980	3,790
At stream mile 2.08	3.0	1,340	2,050	2,360	2,970
At stream mile 2.56	2.0	790	1,240	1,460	1,820
At stream mile 2.83	1.0	320	520	640	770
PILLOT GULLY					
At stream mile 0.00	4.9	1,260	1,770	2,060	2,590
At stream mile 0.36	4.7	1,220	1,720	2,000	2,510
At Cossey Road	3.0	770	1,140	1,360	1,690
At Huffsmith-Kohrville Road	1.5	380	610	760	930
FAULKEY GULLY					
At stream mile 0.00	13.0	3,120	4,440	5,120	6,620
At Malcomson Road	11.4	2,830	4,010	4,610	5,980
At Spring-Cypress Road	7.1	1,970	2,860	3,250	4,140
At stream mile 5.67	1.0	350	550	670	810

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LITTLE CYPRESS CREEK					
At stream mile 0.00	51.2	4,770	6,920	8,450	12,330
At Spring-Cypress Road	45.8	4,480	6,530	7,980	11,660
At Cypress Rosehill Road	40.2	4,190	6,160	7,530	10,990
At stream mile 10.80	28.5	3,310	5,070	6,090	8,800
At stream mile 14.19	20.3	2,430	4,000	4,950	7,430
At Roberts Road	11.1	11,710	2,960	3,770	6,080
At stream mile 20.54	5.0	930	1,680	2,070	2,610
TRIBUTARY 9.36 TO LITTLE CYPRESS CREEK					
At stream mile 0.00	1.7	910	1,340	1,470	1,830
At Wilks Road	0.4	300	440	490	600
TRIBUTARY 10.99 TO LITTLE CYPRESS CREEK					
At stream mile 0.00	5.6	2,260	3,130	3,610	4,620
At stream mile 0.70	3.4	1,540	2,200	2,480	3,140
At stream mile 1.54	2.0	1,030	1,510	1,670	2,090
At stream mile 2.09	1.2	690	1,060	1,140	1,410
TRIBUTARY 13.92 TO LITTLE CYPRESS CREEK					
At stream mile 0.30	3.7	740	1,190	1,470	1,830
At stream mile 1.20	2.1	480	800	960	1,180
At stream mile 2.13	1.5	360	630	750	920
At stream mile 2.52	1.3	330	570	670	820
TRIBUTARY 0.12 TO LITTLE CYPRESS CREEK					
At stream mile 0.00	3.55	720	1,170	1,440	2,180
At stream mile 0.87	3.10	640	1,050	1,290	1,600
DRY CREEK					
At stream mile 0.33	7.71	1,310	1,880	2,220	2,900
At stream mile 2.76	3.61	720	1,080	1,290	1,740
At stream mile 5.36	0.61	160	290	370	550

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 36.6 TO CYPRESS CREEK					
At stream mile 0.00	6.6	490	880	1,150	1,420
At stream mile 0.42	3.9	450	810	1,060	1,310
At stream mile 0.98	3.0	400	710	930	1,140
At stream mile 1.33	2.4	360	650	850	1,040
At stream mile 1.70	1.8	320	580	760	930
At stream mile 1.97	1.4	300	540	700	850
At stream mile 2.41	0.8	260	460	600	730
TRIBUTARY 37.1 TO CYPRESS CREEK*					
At stream mile 0.00	0.69	320	430	490	610
At stream mile 1.17	0.24	150	200	230	290
CHANNEL A TO CYPRESS CREEK					
At stream mile 0.00	3.36	1,160	1,630	1,820	2,270
Upstream of Channel D to Channel A to Cypress Creek	2.03	820	1,140	1,300	1,600
CHANNEL D TO CHANNEL A TO CYPRESS CREEK					
At stream mile 0.00	0.61	360	480	540	670
TRIBUTARY 40.7 TO CYPRESS CREEK					
At stream mile 0.00	4.3	580	1,000	1,280	1,590
At stream mile 1.50	3.3	480	830	1,050	1,290
At stream mile 2.80	1.6	270	500	610	740
At stream mile 3.23	1.0	190	360	430	520
TRIBUTARY 42.7 TO CYPRESS CREEK					
At stream mile 0.00	8.2	770	1,380	1,790	2,240
At stream mile 1.60	7.1	690	1,250	1,610	2,010
At stream mile 2.36	5.4	560	1,030	1,330	1,650
At Mound Road	2.0	260	510	660	800
ROCK HOLLOW					
At stream mile 0.00	10.8	770	1,300	1,690	2,110
At stream mile 2.03	6.9	460	730	920	1,130
At stream mile 4.86	5.7	390	640	810	990
At Mound Road	3.9	290	490	610	740

*Discharges adjusted to reflect basin overflow

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 1.63 TO ROCK HOLLOW					
At stream mile 0.00	2.2	300	530	680	830
At stream mile 0.71	1.7	250	440	560	680
At stream mile 1.92	0.9	150	280	350	420
TRIBUTARY 44.5 TO CYPRESS CREEK					
At stream mile 0.00	6.6	730	1,290	1,670	2,090
At stream mile 2.93	4.2	520	950	1,200	1,480
At stream mile 4.71	1.8	350	660	830	1,010
At stream mile 5.06	1.0	170	340	410	490
MOUND CREEK					
At stream mile 0.00	35.8	4,400	7,400	9,900	15,800
At stream mile 2.73	31.8	4,020	6,790	9,050	14,600
At stream mile 5.46	26.3	3,460	5,810	7,800	12,500
LITTLE MOUND CREEK					
At stream mile 0.00	5.3	660	1,160	1,490	1,860
At Betka Road	4.1	540	970	1,230	1,520
At Burton Cemetery Road	2.5	370	680	850	1,040
TRIBUTARY 7.62 TO MOUND CREEK					
At stream mile 0.00	2.4	460	800	1,010	1,240
At stream mile 0.63	1.2	270	490	600	730
At stream mile 0.80	0.9	220	410	490	590
TRIBUTARY 8.18 TO MOUND CREEK					
At stream mile 2.78	1.1	250	460	560	680
CEDAR BAYOU					
At stream mile 0.00	211.73	5,000	8,400	10,500	15,000
Upstream of confluence of Pine Gully	196.04	12,300	17,500	20,400	25,800
Upstream of confluence of Cary Bayou	173.15	11,100	15,500	17,700	22,300
Upstream of confluence of McGee Gully	164.76	10,500	14,600	16,500	21,000
At stream mile 17.59	161.27	10,300	14,300	16,100	20,500
At stream mile 19.86	149.44	9,300	12,900	15,100	19,600
At stream mile 22.02	138.26	8,400	12,300	14,600	19,000
Upstream of confluence of Adlong Ditch	77.41	4,400	6,700	8,000	11,000
At stream mile 31.63	64.98	3,910	6,100	7,220	10,000
At stream mile 39.41	28.92	2,140	3,480	4,370	6,300

TABLE 3 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
PINE GULLY (Q101-00-00)					
At stream mile 0.00	1.70	750	1,020	1,150	1,420
At stream mile 1.08	1.44	500	700	800	980
DIVERSION CHANNEL					
Upstream of confluence with Galveston Bay	211.90	8,700	13,700	16,250	23,900
CARY BAYOU					
At stream mile 0.00	6.34	2,290	3,160	3,590	4,600
At stream mile 1.50	4.37	1,500	2,070	2,360	3,000
MCGEE GULLY					
At stream mile 0.00	3.75	1,120	1,560	1,790	2,300
At stream mile 1.50	2.69	770	1,060	1,210	1,500
LITTLE CEDAR BAYOU					
At confluence with Galveston Bay	4.32	1,520	2,505	3,027	4,551
Immediately downstream of Fairmont Parkway	3.39	573	984	1,265	2,247
Immediately downstream of East Main Street	2.18	381	659	853	1,583
MUSTANG BAYOU					
At stream mile 7.52	1.99	264	300	314	344

Elevations of the selected recurrence intervals for Addicks and Barker Reservoirs were taken from a COE report (Reference 3.1.14). Elevations for Lake Houston were determined from a stage-discharge analysis of the spillway at Lake Houston Dam. The static elevations determined for the selected recurrence intervals are shown in Table 3A, "Summary of Reservoir Elevations."

TABLE 3A - SUMMARY OF RESERVOIR ELEVATIONS

FLOODING SOURCE	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SHELDON RESERVOIR	48.1	48.5	48.7	49.5
ADDICKS RESERVOIR	97.6	102.4	104.1	107.4
BARKER RESERVOIR	93.0	96.6	97.8	100.3
LAKE HOUSTON	46.3	48.7	49.7	52.7

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources. Both riverine and surge analyses were performed to determine the most significant source of flooding. For the streams studied by riverine methods, cross sections for the backwater analyses were field surveyed. The cross sections were located at close intervals above and below bridges and culverts and supplemented with information from USGS topographic maps in order to compute the significant backwater effects of these structures (Reference 3.1.12). Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1 - see Volumes 4-8). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2). A profile base line is shown on the maps to represent channel distances as indicated on Table 7, "Floodway Data" and/or the flood profiles for certain portions of the West Fork San Jacinto River, Mason Creek and Buffalo Bayou.

Water-surface elevations of the floods of the selected recurrence intervals for the streams studied by detailed methods were computed through the use of the COE HEC-2 step-backwater computer program (Reference 3.2.1). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Some areas of backwater flooding have no profiles, because the profiles would show no changes in the water-surface elevations from the downstream to upstream limits of detailed study. Flood profiles were not drawn for the following streams because they would not show any change in water-surface elevations: Taylor Bayou (A104-00-00), Tributary 3.10 to Taylor Bayou (A104-04-00), Tributary 3.36 to Taylor Bayou (A104-13-00), Tributary 5.44 to Horsepen Bayou (B104-05-00), Tributary 16.8 to West Fork San Jacinto River, Tributary 12.70 to Hunting Bayou (H110-00-00), Tributary 13.85 to Hunting Bayou (H112-00-00), Rummel Creek (W156-00-00), Addicks Reservoir Diversion Channel, Tributary 17.82 to Sims Bayou (C161-00-00), Tributary 21.08 to Spring Creek (J121-00-00), Pine Gully (Q101-00-00), and Diversion Channel (Cedar Bayou Watershed).

Starting water-surface elevations were taken at the mouth of each stream using the slope/area option of the HEC-2 program, with the exception of areas where the slope/area option indicated an elevation less than one foot. In these areas, one foot Mean Sea Level (MSL) was used to show tidal effects. The starting water-surface elevation of the following streams were set at the mean tidal elevation: Clear Creek, Cow Bayou, Tributary 9.97 to Clear Creek, the San Jacinto River, Spring Bayou, Buffalo Bayou, Patrick Bayou, Carpenters Bayou and Greens Bayou. The starting water-surface elevations for White Oak Bayou were set at critical depth since the slope/area option produced elevations below critical depth. The starting water-surface elevations for Lake Houston were determined from a rating curve of Lake Houston Dam.

Basin overflow is a characteristic of many of the drainage basins within Harris County. Basin overflow occurs when the water-surface elevations of a flooding source exceed the elevations of the drainage basin divide. This results in part of the discharge leaving the original flooding source. This situation occurs when a relatively high discharge flows in a flat area where the difference in elevation between the channel and basin divide is small. In Table 3, some of the discharges contain a footnote to identify the occurrence of this situation. These discharges reflect the final discharges used in the hydraulic backwater model and have already had the basin overflow discharge subtracted from the total discharge computed by hydrologic methods. Three hydraulic methods were used to calculate basin overflow: Manning's Equation, Weir Equation, and a known stage-discharge curve.

Manning's Equation and the Weir Equation methods contain many similarities and will be discussed jointly. The equations for these methods are as follows:

Manning's Equation $Q = 1.49/n\ AR^{.67}\ S^{.5}$

Weir Equation $Q = CLH^{1.5}$

where:

Q = overflow discharge
n = Manning's "n" values
A = area
R = hydraulic radius
S = slope in direction of overflow
C = weir coefficient
L = weir length
H = energy head assuming negligible velocities

The Manning's "n" values were determined from field inspection. The weir coefficient was determined from the Handbook of Applied Hydrology and was set at 2.8 (Reference 7.2.2).

The third method used to predict the amount of basin overflow was from a known stage-discharge curve. This method was used to evaluate some of the diversion channels. The stage-discharge relationship was developed from multiple backwater computations.

The computation procedure for all methods is as follows: first, the basin divide line is plotted using the ground elevations at the "ends" of the cross sections used in the backwater computations. Second, an overflow discharge is assumed for each reach (the area between two points of the basin divide) in the overbank areas. Third, each overflow discharge is subtracted from the total discharges for all downstream cross sections to determine the amount of discharge left in the stream. Fourth, backwater computations are performed using the adjusted stream discharges. Fifth, the elevations computed by the backwater analysis are compared to the elevations needed to produce the assumed overflow discharges. A revised overflow discharge is obtained by either averaging the new

overflow discharge with the previously assumed discharge or by using the computed overflow discharge directly. This process is repeated with the newly assumed overflow discharges until the assumed and calculated discharges converge, or until the profile elevations show little change. These computations were performed by hand or by the split flow option of the HEC-2 program (Reference 3.2.1).

Some streams have recorded stream flow data that permitted calibration of roughness coefficients only for low channel flows. In other cases, the selection of roughness coefficients was based on review of aerial photographs, field reconnaissance, channel size and alignment, and channel and overbank ground cover. The channel and overbank "n" values for streams studied by detailed methods are shown in Table 4, "Summary of Roughness Coefficients."

TABLE 4 - SUMMARY OF ROUGHNESS COEFFICIENTS

STREAM NAME	RECEIVING BODY	"n" VALUES CHANNEL	"n" VALUES OVERBANK
Clear Creek Watershed			
Clear Creek	Galveston Bay	0.025-0.060	0.030-0.150
Taylor Bayou	Clear Creek	0.035-0.040	0.020-0.150
Tributary 3.10	Taylor Bayou	0.040-0.045	0.080-0.150
Tributary 3.36	Taylor Bayou	0.040	0.080-0.150
Tributary 3.93	Taylor Bayou	0.040-0.050	0.090-0.150
Cow Bayou	Clear Creek	0.040-0.050	0.045-0.100
Tributary 10.08	Clear Creek	0.015-0.070	0.070-0.150
Cedar Gully	Clear Creek	0.035-0.070	0.035-0.150
Turkey Creek (A119-00-00)	Clear Creek	0.015-0.070	0.090-0.150
Tributary 0.16	Turkey Creek	0.045-0.070	0.070-0.150
Halls Road Ditch	Clear Creek	0.015-0.060	0.070-0.150
Armand Bayou	Clear Creek	0.030-0.060	0.030-0.150
Horsepen Bayou	Armand Bayou	0.015-0.090	0.090-0.150
Tributary 4.51	Horsepen Bayou	0.040-0.070	0.090-0.150
Tributary 5.44	Horsepen Bayou	0.040	0.090
Big Island Slough	Armand Bayou	0.045-0.060	0.090-0.150
Spring Gully (B109-00-00)	Armand Bayou	0.035-0.045	0.090-0.150
Tributary 9.39	Armand Bayou	0.045-0.055	0.070-0.150
Willow Springs Bayou	Armand Bayou	0.015-0.045	0.090-0.150
Tributary 1.78	Willow Springs Bayou	0.015-0.050	0.090-0.150
Tributary B	Willow Springs Bayou	0.015-0.060	0.045-0.080
Tributary 10.46	Armand Bayou	0.040-0.060	0.090-0.150
Tributary 12.18	Armand Bayou	0.035	0.090-0.150
San Jacinto River Watershed			
San Jacinto River	Galveston Bay	0.030-0.035	0.040-0.130
Lake Houston	San Jacinto River	0.030-0.040	0.110-0.120
Goose Creek	San Jacinto River	0.015-0.060	0.030-0.120

TABLE 4 - SUMMARY OF ROUGHNESS COEFFICIENTS - continued

STREAM NAME	RECEIVING BODY	"n" VALUES CHANNEL	"n" VALUES OVERBANK
East Fork Goose Creek	Goose Creek	0.015-0.045	0.035-0.060
Spring Gully (0200-00-00)	San Jacinto River	0.040-0.060	0.110-1.000
Jackson Bayou	San Jacinto River	0.040-0.045	0.085-0.110
Gum Gully	Jackson Bayou	0.045	0.110
Tributary 2.70	Gum Gully	0.045-0.050	0.110
Tributary 3.08	Gum Gully	0.045-0.050	0.110-0.120
West Fork San Jacinto River	Lake Houston	0.030-0.120	0.030-0.120
Bens Branch	West Fork San Jacinto River	0.015-0.070	0.015-0.990
Jordan Gully	West Fork San Jacinto River	0.030-0.065	0.090-0.120
Tributary 16.8	West Fork San Jacinto River	0.035-0.040	0.060-0.100
Tributary 17.7	West Fork San Jacinto River	0.030-0.055	0.060-0.100
East Fork San Jacinto River	Lake Houston	0.040-0.050	0.070-0.130
Luce Bayou	East Fork San Jacinto River	0.050-0.060	0.110-0.120
Shook Gully	Luce Bayou	0.060	0.110-0.120
Mexican Gully	Luce Bayou	0.060	0.110-0.120
Caney Creek	East Fork San Jacinto River	0.040	0.110-0.120
White Oak Creek	Caney Creek	0.060	0.120
Taylor Gully	Caney Creek	0.015-0.040	0.110
Mills Branch	White Oak Creek	0.060	0.110-0.120
	Buffalo Bayou Watershed		
Buffalo Bayou	San Jacinto River	0.025-0.060	0.060-0.150
Buffalo Bayou Split Flow	Buffalo Bayou	0.060-0.070	0.150
Patrick Bayou	Buffalo Bayou	0.030-0.060	0.070-0.080
East 13th Street Outfall Channel	Patrick Bayou	0.015-0.060	0.045-0.080
Glenmore Ditch	Buffalo Bayou	0.015-0.040	0.080-0.150
Carpenters Bayou	Buffalo Bayou	0.015-0.040	0.015-0.120
Tributary 3.33	Carpenters Bayou	0.014-0.050	0.060-0.150
Tributary 11.715	Carpenters Bayou	0.014-0.050	0.050-0.120
Tributary 6.77	Buffalo Bayou	0.030	0.050
Hunting Bayou	Buffalo Bayou	0.014-0.060	0.070-0.120
Tributary 5.22	Hunting Bayou	0.014-0.070	0.018-0.120
Tributary 12.05	Hunting Bayou	0.050	0.070-0.150
Tributary 12.70	Hunting Bayou	0.050	0.150

TABLE 4 - SUMMARY OF ROUGHNESS COEFFICIENTS - continued

STREAM NAME	RECEIVING BODY	"n" VALUES CHANNEL	OVERBANK
Tributary 13.85	Hunting Bayou	0.012-0.050	0.150
Tributary 8.17	Buffalo Bayou	0.040	0.050
Vince Bayou	Buffalo Bayou	0.015-0.040	0.085-0.150
Little Vince Bayou	Vince Bayou	0.012-0.035	0.100-0.150
Panther Creek	Buffalo Bayou	0.050	0.080-0.120
Spring Branch	Buffalo Bayou	0.013-0.060	0.060-0.150
Briar Branch	Spring Branch	0.017-0.050	0.030-0.150
Bering Ditch	Buffalo Bayou	0.045	0.120
Rummel Creek	Buffalo Bayou	0.050	0.120
Turkey Creek (W167-00-00)	Buffalo Bayou	0.012-0.040	0.080-0.500
Tributary 3.9	Turkey Creek	0.040	0.060
Langham Creek	Bear Creek	0.040-0.050	0.060-0.150
Addicks Reservoir Diversion Channel	Langham Creek/ Addicks Reservoir	0.035	0.080-0.150
South Mayde Creek	Addicks Reservoir	0.015-0.060	0.080-0.150
Tributary 9.4	South Mayde Creek	0.040-0.045	0.090
Bear Creek	South Mayde Creek	0.035-0.050	0.080-0.150
Horsepen Creek	Langham Creek	0.040-0.060	0.090-0.100
Dinner Creek	Langham Creek	0.035-0.050	0.080-0.150
Clodine Ditch	Buffalo Bayou	0.035	0.070
Cane Island Branch	Buffalo Bayou	0.040-0.045	0.060-0.100
Mason Creek	Buffalo Bayou	0.015-0.055	0.035-0.100
Tributary 4.96	Mason Creek	0.015-0.040	0.070
Tributary 52.9	Buffalo Bayou	0.050	0.070-0.100
Tributary 2.17	Tributary 52.9	0.040	0.080-0.100
Greens and Halls Bayous Watershed			
Greens Bayou	Buffalo Bayou	0.012-0.055	0.040-0.120
Big Gulch	Greens Bayou	0.013-0.080	0.070-0.150
Sulphur Gully	Greens Bayou	0.012-0.070	0.100
Spring Gully (P110-00-00)	Greens Bayou	0.080	0.100-0.120
Halls Bayou	Greens Bayou	0.015-0.060	0.030-0.150
Tributary 6.71	Halls Bayou	0.050-0.070	0.100-0.120
Tributary 11.96	Halls Bayou	0.015-0.050	0.100
Tributary 14.27	Greens Bayou	0.013-0.070	0.090-0.120
Tributary 14.82	Greens Bayou	0.060-0.070	0.100-0.120
Garners Bayou	Greens Bayou	0.035-0.050	0.070-0.120
Williams Gully	Garners Bayou	0.040-0.060	0.040-0.120
Tributary 2.01	Williams Gully	0.045-0.060	0.080-0.120
Tributary 3.19	Garners Bayou	0.050	0.080
Tributary 0.55	Tributary 3.19	0.040-0.070	0.060-0.080
Reinhardt Bayou	Garners Bayou	0.040-0.065	0.070-0.120
Tributary 20.88	Greens Bayou	0.014-0.090	0.050-0.120

TABLE 4 - SUMMARY OF ROUGHNESS COEFFICIENTS - continued

STREAM NAME	RECEIVING BODY	"n" VALUES CHANNEL	"n" VALUES OVERBANK
Tributary 24.97	Greens Bayou	0.060	0.080-0.100
Tributary 26.64	Greens Bayou	0.013-0.070	0.045-0.120
P155-00-00	Greens Bayou	0.015-0.040	0.070
P156-00-00	Greens Bayou	0.015-0.040	0.070
North Fork Greens Bayou	Greens Bayou	0.015-0.050	0.080-0.120
Tributary 1.95	North Fork Greens Bayou	0.012-0.060	0.070-0.100
Tributary 32.23	Greens Bayou	0.013-0.075	0.060-0.120
Tributary 34.60	Greens Bayou	0.040-0.070	0.070
	Brays Bayou Watershed		
Sims Bayou	Buffalo Bayou	0.040-0.055	0.100-0.160
Plum Creek	Sims Bayou	0.014-0.065	0.045-0.120
Pine Gully	Sims Bayou	0.040-0.090	0.080-0.150
Berry Bayou	Sims Bayou	0.017-0.040	0.040-0.500
Tributary 2.00	Berry Bayou	0.040-0.080	0.080-0.120
Tributary 3.31	Berry Bayou	0.040	0.080-0.120
Tributary 10.12	Sims Bayou	0.045	0.120
Tributary 10.77	Sims Bayou	0.019-0.080	0.080-0.120
Tributary 13.83	Sims Bayou	0.040-0.045	0.080-0.150
Tributary 17.82	Sims Bayou	0.040	0.090-0.100
Tributary 20.25	Sims Bayou	0.019-0.060	0.060-0.120
Brays Bayou	Buffalo Bayou	0.013-0.050	0.030-0.120
Willow Waterhole Bayou	Brays Bayou	0.017-0.040	0.030-0.150
Chimney Rock Diversion Channel	Brays Bayou	0.017-0.035	0.016-0.120
Tributary 17.42	Brays Bayou	0.020	0.120
Fondren Diversion Channel	Brays Bayou	0.017-0.065	0.035-0.120
Keegans Bayou	Brays Bayou	0.015-0.040	0.070-0.120
Tributary 19.77	Brays Bayou	0.045	*
Tributary 20.86	Brays Bayou	0.040	0.120
Tributary 20.90	Brays Bayou	0.040	*
Tributary 21.95	Brays Bayou	0.040	*
Tributary 22.69	Brays Bayou	0.040	*
Tributary 23.53	Brays Bayou	0.040	*
Tributary 26.20	Brays Bayou	0.035	0.080-0.120
Tributary 29.16	Brays Bayou	0.035	*
	White Oak Bayou Watershed		
White Oak Bayou	Buffalo Bayou	0.012-0.050	0.035-0.120
Little White Oak Bayou	White Oak Bayou	0.020-0.060	0.050-0.120
Brickhouse Gully	White Oak Bayou	0.014-0.025	0.060-1.000

*Data not available

TABLE 4 - SUMMARY OF ROUGHNESS COEFFICIENTS - continued

STREAM NAME	RECEIVING BODY	"n" VALUES CHANNEL	OVERBANK
Tributary 1.61	Brickhouse Gully	0.015-0.040	0.120-0.500
Tributary 10.1	White Oak Bayou	0.040	0.120-0.500
Cole Creek	White Oak Bayou	0.014-0.045	0.110-0.120
Vogel Creek	White Oak Bayou	0.040	0.120-1.000
Tributary 15.8	White Oak Bayou	0.015-0.045	0.080-0.120
Rolling Fork	White Oak Bayou	0.013-0.060	0.060-0.150
Tributary 19.05	White Oak Bayou	0.025-0.090	0.030-0.100
Tributary 19.82	White Oak Bayou	0.025-0.090	0.030-0.100
Spring and Cypress Creeks Watershed			
Spring Creek	West Fork San Jacinto River	0.060-0.080	0.175
Bender Lake	Spring Creek	0.080	0.175
Tributary 21.08	Spring Creek	0.080	0.175
Willow Creek	Spring Creek	0.050-0.070	0.090-0.175
Tributary 0.26	Willow Creek	0.055	0.175
Tributary 2.44	Willow Creek	0.020-0.040	0.060-0.175
Hughes Gully	Willow Creek	0.060-0.080	0.175
Cannon Gully	Willow Creek	0.040	0.175
Metzler Creek	Cannon Gully	0.040	0.175
Tributary 6.52	Willow Creek	0.060	0.090-0.175
Tributary 8.16	Willow Creek	0.055-0.070	0.090-0.175
Tributary 13.50	Willow Creek	0.055	0.100
Boggs Gully	Spring Creek	0.045-0.070	0.070-0.120
Tributary 1.25	Boggs Gully	0.055	0.070-0.085
Cypress Creek	Spring Creek	0.035-0.045	0.040-0.990
Turkey Creek (K111-00-00)	Cypress Creek	0.015-0.045	0.050-0.110
Wild Cow Gulch	Cypress Creek	0.015-0.045	0.070
Schultz Gully	Cypress Creek	0.015-0.045	0.015-0.070
Lemm Gully	Cypress Creek	0.045	0.070-0.110
Senger Gully	Lemm Gully	0.045	0.070-0.150
Wunsche Gully	Lemm Gully	0.045	0.080
Seals Gully	Cypress Creek	0.045	0.070-0.150
Kothman Gully	Seals Gully	0.015-0.045	0.100-0.110
Spring Gully (K131-00-00)	Cypress Creek	0.035-0.045	0.070-0.110
Theiss Gully	Spring Gully	0.045	0.070-0.150
Tributary 2.1	Spring Gully	0.015-0.045	0.070-0.150
Dry Gully	Cypress Creek	0.015-0.040	0.050
Pillot Gully	Cypress Creek	0.045-0.050	0.050-0.990
Faulkey Gully	Cypress Creek	0.040-0.045	0.040-0.150
Little Cypress Creek	Cypress Creek	0.045	0.070-0.110
Tributary 9.36	Little Cypress Creek	0.045	0.070-0.110
Tributary 10.99	Little Cypress Creek	0.045	0.080-0.090
Tributary 13.92	Little Cypress Creek	0.045-0.050	0.070-0.090
Tributary 0.12	Tributary 13.92	0.045	0.070-0.080

TABLE 4 - SUMMARY OF ROUGHNESS COEFFICIENTS - continued

STREAM NAME	RECEIVING BODY	"n" VALUES CHANNEL	OVERBANK
Dry Creek	Cypress Creek	0.045-0.070	0.060-0.110
Tributary 36.6	Cypress Creek	0.045	0.070
Tributary 37.1	Cypress Creek	0.045	0.070
Channel A	Cypress Creek	0.013-0.050	0.050-0.100
Channel D	Channel A	0.015-0.040	0.015-0.040
Tributary 40.7	Cypress Creek	0.045	0.070
Tributary 42.7	Cypress Creek	0.045	0.060-0.070
Rock Hollow	Cypress Creek	0.030-0.045	0.070
Tributary 1.63	Rock Hollow	0.040	0.070
Tributary 44.5	Cypress Creek	0.045	0.070
Mound Creek	Cypress Creek	0.045	0.045-0.150
Little Mound Creek	Mound Creek	0.045	0.070
Tributary 7.62	Mound Creek	0.045	0.070
Tributary 8.18	Mound Creek	0.040-0.060	0.070
	Cedar Bayou		
Cedar Bayou	Galveston Bay	0.035-0.045	0.080-0.150
Pine Gully (0101-00-00)	Cedar Bayou	0.045	0.120
Diversion Channel	Cedar Bayou	0.035	0.120
Cary Bayou	Cedar Bayou	0.040-0.065	0.090-0.120
McGee Gully	Cedar Bayou	0.035-0.050	0.080-0.130
Little Cedar Bayou	Cedar Bayou	0.040-0.070	0.090-0.150
	Mustang Bayou		
Mustang Bayou	Chocolate Bay	0.060-0.065	0.120-0.130

The approximate flood elevations for Spring Creek upstream of river mile 48.22 were based on a study entitled 100-Year Flood Plain Study on Spring Creek (Reference 3.2.3). The study incorporated surveyed cross sections, hydrologic analyses and automated backwater computations approaching the complexity used in the analyses of detailed study streams. However, difference in hydrologic analyses and the versions of the computer program used for backwater computations, together with a significantly greater degree of topographic data with this study, resulted in minor differences in the flood elevations predicted in the two studies. Part of these differences can be attributed to minor land subsidence in the area. The differences were reconciled by incorporating a gradual transition between the floodplains in the two studies. The flood elevations for the portion of Cedar Bayou studied by approximate methods were based on the Flood Plain Information report on Cedar Bayou prepared by the COE in June 1972 (Reference 3.2.4).

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed, and dams and other flood control structures operate properly and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3 - see Volume 3). It should be noted that elevations of these reference marks were established by the Galveston District of the COE based on the 1973 releveling performed by the National Geodetic Survey (NGS). In some cases, the 1973 elevation of an NGS benchmark established by the COE may not be in agreement with the 1973 elevation published by the NGS. In these cases, only the 1973 elevation established by the COE and shown on the Flood Insurance Rate Map should be used in determining elevations of structures in relation to the base (100-year) flood elevations published in this study.

3.3 Coastal Analyses

Analyses of the shoreline characteristics of the tidal flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shorelines.

To establish the 10-, 50-, 100- and 500-year flood elevations in Galveston Bay, the standard FEMA coastal surge model was used to simulate the coastal surge generated by any chosen storm (any combination of the five storm parameters previously defined). Performing such simulations for a large number of storms, each of a known probability, permitted the establishment of the frequency distribution of stillwater elevations as a function of coastal location. It should be noted that these distributions incorporate the large scale surge behavior, but do not include an analysis of the added effects of wave height, setup or runup.

The determination of coastal inundation caused by the passage of hurricanes was calculated using a two-dimensional joint probability analysis (Reference 3.3.1). The storm population was described by probability distributions of five parameters that influence stillwater elevations. These five parameters were central pressure depression (which measures the intensity of the storm), radius to maximum winds, forward speed of the storm, shoreline crossing point, and crossing angle. These parameters, or storm characteristics, were described statistically based on an analysis of observed storms in the vicinity of Galveston Bay. Primary sources of these data were provided by the National Weather Service, the National Hurricane Research Project and the Monthly Weather Review (References 3.3.2, 3.3.3, 3.3.4, 3.3.5 and 3.3.6). The astronomic tide for the region was statistically combined with the computed

storm surge to yield recurrence intervals of total water level. This procedure is outlined in the Coastal Flooding Handbook (Reference 3.3.7).

A one-dimensional unsteady branch flow model was used to determine stillwater elevations along the streams and tidal estuaries in Harris County (Reference 3.3.8). The one-dimensional surge model is the same as described in the Coastal Flooding Handbook except in its capability of handling hydraulic parameters that vary with elevations (Reference 3.3.7). With that addition, the model is able to incorporate the physical aspects of natural stream channels and their floodplains. The streams and tidal estuaries studied in Harris County included Galveston Bay, Clear Lake and Clear Creek, Taylor Lake and Taylor Bayou, Forrest Lake, Armand Bayou, Cedar Bayou, the San Jacinto River, Buffalo Bayou, Greens Bayou, Halls Bayou, White Oak Bayou and Brays Bayou.

Both the two-dimensional surge model and one-dimensional model were verified with data from Hurricane Carla (Reference 2.3.1). Computations of the stillwater elevations along the streams and estuaries were performed excluding the effects of rainfall runoff.

After an analysis of riverine flooding and an analysis of tidal flooding was completed along Cedar Bayou and Clear Creek, the events were calculated using combined probabilities. For specific elevations, the recurrence intervals of separate events were added together to find the recurrence interval for the combined event. The following equation was used:

$$1/T_R \text{ combined} = 1/[1/T_R \text{ riverine} + 1/T_R \text{ surge}]$$

where T_R riverine is the recurrence interval of the riverine event at a specific elevation, T_R surge is the recurrence interval of the tidal event at the same elevation, and T_R combined is the recurrence interval of the combined riverine and tidal event at the same elevation.

The analysis of wave action in this Flood Insurance Study involves consideration of wave height, which is the distance from the trough to the crest of the wave. Wave action increases the water-surface elevations in a flood event. The height of a wave is dependent upon wind speed and its duration, depth of water, and length of fetch. The wave crest elevation is the sum of the stillwater elevation and the portion of the wave height above the stillwater elevation.

Wave heights and corresponding wave crest elevations were determined using the National Academy of Sciences (NAS) methodology (Reference 3.3.9). The stillwater elevations, the combined stillwater and riverine elevations, and the maximum wave crest elevations for sources affected by tidal flooding of the selected recurrence intervals are shown in Table 5, "Summary of Elevations."

TABLE 5 - SUMMARY OF ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
GALVESTON BAY				
At mouth of Clear Lake	4.8[1]	9.8[1]	11.5/18[2]	14.9[1]
At Todville	5.2[1]	9.8[1]	11.6/18[2]	15.2[1]
At Pine Gully	5.3[1]	9.9[1]	11.7/18[2]	15.3[1]
At Red Bluff	5.3[1]	10.0[1]	11.8/18[2]	15.4[1]
At split of Cedar Bayou and Diversion Channel	5.3[1]	10.5[1]	12.2[1]	16.7[1]
At Shoreacres	5.4[1]	10.2[1]	12.1/18[2]	15.7[1]
At State Route 146 bridge over Cedar Bayou	5.4[1]	10.5[1]	12.2[1]	15.7[1]
At southern corporate limits	5.4[1]	10.3[1]	12.4/18[2]	15.9[1]
At Sylvan Beach	5.6[1]	10.5[1]	12.4/19[2]	16.1[1]
At Bayridge Park	5.6[1]	10.6[1]	12.5/19[2]	16.3[1]
At Houston Ship Channel	5.7[1]	10.5[1]	12.4/15[2]	16.7[1]
At Cedar Bayou	5.3[1]	10.4[1]	12.2/18[2]	15.8[1]
Northwest of Ash Lake	5.4[1]	10.8[1]	12.6/19[2]	16.4[1]
At confluence of Diversion Channel	5.4[1]	10.6[1]	12.4/19[2]	16.1[1]
CLEAR LAKE AND CREEK				
At confluence with Forrest Lake	4.8[1]	9.6[1]	11.4/15[2]	14.7[1]
Entire shoreline affecting City of El Lago	4.8[1]	9.6[1]	11.3/15[2]	14.7[1]
Entire shoreline affecting City of Seabrook	4.8[1] [3]	9.6[1] [3]	11.3/15[2] [4]	14.7[1] [3]
At Bal Harbor Cove	5.1[1]	9.6[1]	11.4/14[4]	14.7[1]
At Swan Lagoon	5.2[1] [3]	9.6[1] [3]	11.4/14[4]	14.7[1] [3]
Immediately below Swan Lagoon	5.2[3]	9.6[3]	11.4/14[3]	14.7[3]
At confluence of Cow Bayou	6.5[3]	9.8[3]	11.4[3]	14.6[3]
At Interstate Route 45	8.7[3]	10.8[3]	12.2[3]	14.7[3]
1.0 mile upstream from Interstate Route 45	10.1[3]	12.2[3]	13.2[3]	16.6[3]
Approximately 2.0 miles Upstream of Interstate Route 45	10.9[3]	12.9[3]	13.9[3]	16.9[3]
TAYLOR LAKE AND TAYLOR BAYOU				
Entire shoreline affecting City of El Lago	4.8[1]	9.6[1]	11.4[1]	14.7[1]
At Mile 1.3	4.8[1]	9.6[1]	11.4[1]	14.8[1]
At Mile 1.8	4.8[1]	9.7[1]	11.4[1]	14.8[1]
At Port Road	4.8[1]	9.7[1]	11.4[1]	14.8[1]

[1]Stillwater elevation
[2]Stillwater elevation/maximum wave crest elevation
[3]Combined stillwater and riverine elevation
[4]Combined stillwater and riverine elevation/maximum wave crest elevation

TABLE 5 - SUMMARY OF ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TAYLOR LAKE AND TAYLOR BAYOU (continued)				
At Red Bluff Road	4.8[1]	9.7[1]	11.4[1]	14.8[1]
At State Route 146	4.8[1]	9.7[1]	11.4[1]	14.8[1]
At McCabe Road	4.8[1]	9.7[1]	11.4[1]	14.8[1]
Entire shoreline within City of Shoreacres	4.8[1]	9.7[1]	11.4[1]	14.8[1]
COW BAYOU				
At the confluence with Clear Creek	6.5[1]	9.8[1]	11.4[1]	14.6[1]
ARMAND BAYOU				
At Bay Area Boulevard	4.8[1]	9.7[1]	11.5[1]	14.8[1]
FORREST LAKE				
At the confluence with Clear Lake	4.8[1]	9.6[1]	11.4/15[2]	14.7[1]
Across from Honey Oats Drive	4.8[1]	9.7[1]	11.4[1]	14.8[1]
SPRING GULLY (0200-00-00)				
At Spring Gully	5.3[1]	10.0[1]	11.6[1]	15.0[1]
SAN JACINTO RIVER				
At confluence of Goose Creek	5.4[1]	10.4[1]	12.2/14[2]	15.9[1]
Approximately 0.5 mile downstream of State Route 146	5.4[1]	10.4[1]	12.2/15[2]	15.9[1]
At Market Road bridge over Goose Creek	5.4[1]	10.5[1]	12.2[1]	15.9[1]
At confluence of Barbors Cut	5.4[1]	10.6[1]	12.4/15[2]	16.1[1]
At northwestern portion of Hogg Island	5.4[1]	10.5[1]	12.3/15[2]	16.0[1]
At State Route 146	5.3[1]	10.3[1]	12.0/15[2]	15.6[1]
At Black Duck Bay	5.3[1]	10.2[1]	11.8/15[2]	15.3[1]
At northern portion of Black Duck Bay	5.3[1]	10.1[1]	11.8/15[2]	15.2[1]

[1]Stillwater elevation
[2]Stillwater elevation/maximum wave crest elevation

TABLE 5 - SUMMARY OF ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SAN JACINTO RIVER (continued)				
At southern portion of Mitchel Bay	5.3[1]	10.2[1]	11.8/15[2]	15.2[1]
At Mitchel Bay	5.3[1]	10.2[1]	11.8/15[2]	15.3[1]
At Hampleton Avenue (extended)	5.3[1]	10.1[1]	11.8/15[3]	15.2[1]
At Scott Bay	5.3[1]	10.2[1]	11.8/15[2]	15.2[1]
At Crystal Bay	5.3[1]	10.1[2]	11.7/15[2]	15.1[1]
Downstream side of State Route 134	5.3[1]	10.0[1]	11.6/15[2]	15.0[1]
At confluence of Spring Gully (0200-00-00)	5.3[1]	10.0[1]	11.6/15[2]	15.0[1]
Across from Lynchburg Reservoir	5.2[1]	9.8[1]	11.4/14[2]	14.8[1]
Approximately 0.5 mile downstream of Interstate Route 10	5.0[1]	9.5[1]	11.2/14[2]	14.6[1]
Upstream side of Interstate Route 10	4.9[1]	9.4[1]	11.0/14[2]	14.4[1]
BUFFALO BAYOU				
At confluence with San Jacinto River	5.2[1]	9.8[1]	11.4[1]	14.8[1]
At confluence of Boggy Bayou Basin	5.2[1]	9.9[1]	11.5[1]	14.8[1]
Approximately 0.8 mile downstream of confluence of Greens Bayou	5.2[1]	9.9[1]	11.5[1]	14.9[1]
At confluence of Hunting Bayou	5.3[1]	10.0[1]	11.6[1]	15.0[1]
At confluence of Vince Bayou	5.3[1]	10.0[1]	11.6[1]	15.0[1]
At confluence of Cotton Patch Bayou	5.3[1]	10.0[1]	11.6[1]	15.0[1]
CEDAR BAYOU				
At confluence with Galveston Bay	5.3[1][3]	10.4[1][3]	12.2/17[2][3]	15.8[1][3]
At Missouri Pacific Railroad	6.1[3]	11.0[3]	12.8[3]	16.4[3]
At Ferry Road	10.8[3]	15.3[3]	16.9[3]	21.1[3]

[1]Stillwater elevation
[2]Stillwater elevation/maximum wave crest elevation
[3]Combined stillwater and riverine elevation

TABLE 5 - SUMMARY OF ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LITTLE CEDAR BAYOU				
Approximately 0.2 mile upstream of Old State Route 146	5.6[1]	10.6[1]	12.5[1]	16.3[1]

[1]Stillwater elevation
[2]Stillwater elevation/maximum wave crest elevation

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The COE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (Reference 3.3.10). The 3-foot wave has been determined as the minimum size wave capable of causing major damage to conventional wood frame or brick veneer structures. This criterion has been adopted by the FEMA for the determination of V-zones.

The methodology for analyzing wave heights and corresponding wave crest elevations was developed by the NAS (Reference 3.3.9). The NAS methodology is based on three major concepts. First, a storm surge on the open coast is accompanied by waves. The maximum height of these waves is related to the depth of water by the following equation:

$$H_b = 0.78d$$

where H_b is the crest to trough height of the maximum or breaking wave and d is the stillwater depth. The elevation of the crest of an unimpeded wave is determined using the equation:

$$Z_w = S_* + 0.7H_* = S_* + 0.55d$$

where Z_w is the wave crest elevation, S_* is the stillwater elevation at the site, and H_* is the wave height at the site. The 0.7 coefficient is the portion of the wave height which reaches above the stillwater elevation. H_b is the upper limit for H_*.

The second major concept is that the breaking wave height may be diminished by dissipation of energy by natural or man-made obstructions. The wave height transmitted past a given obstruction is determined by the following equation:

$$H_t = BH_i$$

where H_t is the transmitted wave height, H_i is the incident wave height, and B is a transmission coefficient ranging from 0.0 to 1.0. The coefficient is a function of the physical characteristics of the obstruction. Equations have been developed by the NAS to determine B for vegetation, buildings, natural barriers such as dunes, and manmade barriers such as breakwaters and seawalls (Reference 3.3.9).

The third concept deals with unimpeded reaches between obstructions. New wave generation can result from wind action. This added energy is related to distance and mean depth over the unimpeded reach.

These concepts and equations were used to compute wave heights and wave crest elevations associated with the 100-year storm surge. Accurate topographic, land-use, and land cover data are required for the wave height analysis. Topographic data for the wave height calculations were obtained from USGS topographic maps at a scale of 1:24,000 enlarged to a scale of 1:12,000 with a contour interval of 5 feet (Reference 3.1.11). Land-use and land cover data were obtained from aerial photographs at a scale of 1"=18,000' (Reference 3.3.11).

Wave heights were computed along transects, which were located perpendicular to the average mean shoreline. The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, the transects were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects. Figure 5, "Transect Location Map", illustrates the location of the transects for the county.

Along each transect, wave heights and wave crest elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. Wave heights were calculated to the nearest 0.1 foot, and wave crest elevations were determined at whole-foot increments along the transects. The calculations were carried inland along the transect until the wave crest elevation was permanently less than 0.5 foot above the

FIGURE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRIS COUNTY, TX
AND INCORPORATED AREAS

APPROXIMATE SCALE

7000 0 7000 14000 21000 FEET

TRANSECT LOCATION MAP

stillwater surge elevation or the coastal flooding met another flooding source (i. e. riverine) with an equal water-surface elevation. The results of the calculations are accurate until local topography, vegetation, or cultural development of the community undergo any major changes. The results of the wave height analysis are shown in Table 6.

TABLE 6 - TRANSECT DATA

Flooding Source	Stillwater Elevation 10-Year	100-Year	Zone	Base Flood Elevation (Feet NGVD)*
CLEAR CREEK				
Transect 1	4.8	11.4	VE	14
			AE	11-14
CLEAR LAKE				
Transect 2	4.8	11.4	VE	14
			AE	11-14
Transects 3-4	4.8	11.4	VE	14-15
			AE	11-14
Transect 5	4.8	11.3	VE	13-15
Transect 6	4.8	11.3	VE	13-15
			AE	11-13
GALVESTON BAY				
Transects 7-9	4.8	11.5	VE	14-18
			AE	12-14
Transects 10-11	5.2	11.6	VE	14-18
			AE	12-14
Transect 12	5.3	11.7	VE	14-18
			AE	12-14
Transects 13-14	5.3	11.8	VE	14-18
			AE	12-14
Transects 15-16	5.3	12.1	VE	14-17
			AE	12-14
Transect 17	5.4	12.4	VE	15-17
			AE	12-15
Transects 18-19	5.4	12.4	VE	15-18
			AE	12-14
Transect 20	5.6	12.4	VE	15-19
			AE	12-14
Transect 21	5.6	12.4	VE	15-17
			AE	12-15
Transects 22-24	5.6	12.5	VE	15-19
			AE	13-15

*Because of map-scale limitations, base flood elevations shown on the Flood Insurance Rate Map may represent average elevations for the zones depicted

TABLE 6 - TRANSECT DATA - continued

Flooding Source	Stillwater Elevation 10-Year	Stillwater Elevation 100-Year	Zone	Base Flood Elevation (Feet NGVD)*
GALVESTON BAY (continued)				
Transects 25-28	5.4	12.4	VE	15
			AE	12-15
Transect 29	5.4	12.3	VE	14-15
			AE	12-14
Transects 30-32	5.3	12.2	VE	14-17
			AE	12-14
Transects 33-35	5.4	12.6	VE	15-19
SAN JACINTO RIVER				
Transect 36	5.4	12.4	VE	15-16
Transects 37-40	5.4	12.3	VE	14-15
Transect 41	5.3	11.8	VE	14-15
			AE	12-14
Transects 42-47	5.3	11.8	VE	14-15
Transects 48-49	5.3	11.7	VE	14-15
Transects 50-52	5.3	11.6	VE	14-15
			AE	12-14
Transect 53	5.3	11.6	VE	14-16
			AE	12-14
Transect 54	5.3	11.6	VE	14-15
			AE	12-14
Transect 55	5.0	11.2	VE	14
			AE	11-14
Transect 56	5.3	11.6	VE	14-16
			AE	12-14
Transects 57-59	5.3	11.7	VE	14-15
			AE	12-14
Transects 60-70	5.3	11.8	VE	14-15
			AE	12-14

*Because of map-scale limitations, base flood elevations shown on the FIRM may represent average elevations for the zones depicted

Water-surface elevations were determined for the flooding sources in this study by determining whether riverine or surge flooding governed. The flooding type producing the greater water-surface elevations was used and depicted on the FIRM.

3.4 Effects of Land Subsidence on Flood Analyses

Properties within the study area may be subject to stream flooding, tidal flooding, or a combination of both. The development of flood hazard data for these flooding conditions poses a straightforward engineering problem that can be resolved using generally accepted techniques. However, the existence of ongoing land subsidence in the study area complicates the application of these flood hazard data to flood insurance purposes (Reference 3.4.1). The degree of complication depends on the type of flooding involved, since different methods must be used to adjust data for stream, tidal, or combination flooding.

As previously mentioned, the flood elevations contained in this report are referenced to the NGVD. The National Geodetic Survey (NGS) has established benchmarks throughout the nation for public use in measuring elevations with reference to the NGVD. The NGS conducts periodic releveling surveys to account for elevation changes such as those resulting from land subsidence occurring in the study area. A relatively extensive releveling was conducted in this area in 1973, and a less extensive releveling was undertaken in 1978. The elevations of the reference marks used in this study were established by the Galveston District COE, on the basis of the 1973 releveled benchmarks. In some cases, the elevation determined by the COE for an NGS benchmark may not be in exact agreement with the 1973 elevation published by the NGS because land subsidence may have occurred between the releveling in 1973 and the COE's establishment of the new elevation. Only the COE elevations based on the 1973 releveling and shown in this study should be used in determining elevations of structures in relation to the Base (100-year) Flood Elevations published in this study.

For riverine flooding, flood data contained in this report are referenced to the 1973 releveling of the NGVD, with the exception of the following streams, which are referenced to the 1978 adjustment: Goose Creek, East Fork Goose Creek, Dry Creek, Tributary 37.1 to Cypress Creek, Channel A to Cypress Creek, and Channel D to Channel A to Cypress Creek. The data are correct when compared to land elevations existing in 1973 but could be in error when compared with elevations taken at later dates. Constant restudy of the subsiding area is not necessary, however, since an adjustment can make the flood data useful for a relatively long time. The adjustment is based on the assumption that subsidence is relatively uniform over a given area. Therefore, as Figure 6 illustrates, regardless of the amount of land subsidence, a riverine floodplain of a given area and depth will remain relatively constant in relation to the surrounding terrain. In other words, for a structure located within the floodplain, the estimated depth of flooding from a flood of a given frequency will not change regardless of the amount of land subsidence. It is important to recognize that this concept applies only to areas affected by riverine flooding and is not valid in areas subject to hurricane-tidal surges.

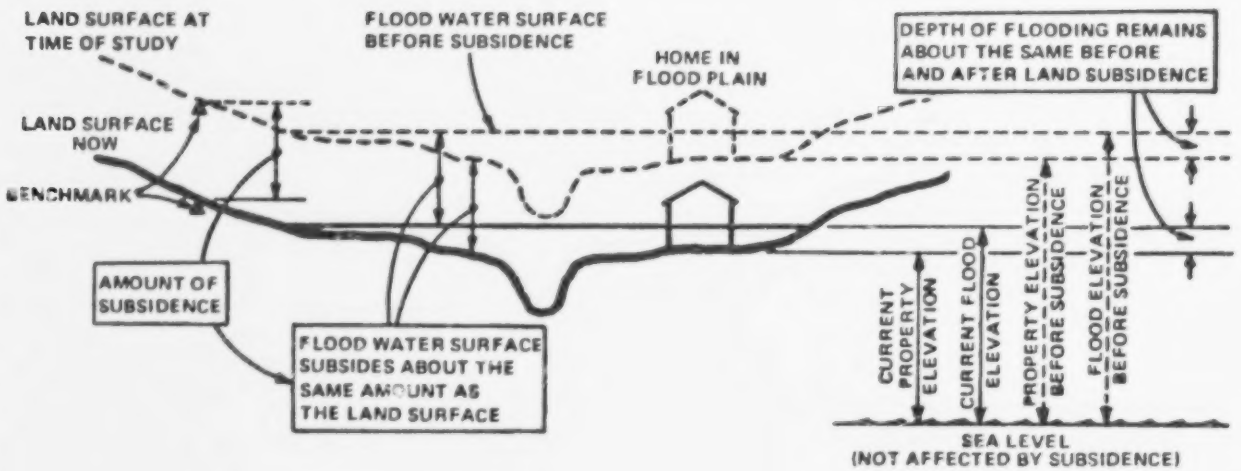

LAND SURFACE AT TIME OF STUDY
FLOOD WATER SURFACE BEFORE SUBSIDENCE
HOME IN FLOOD PLAIN
DEPTH OF FLOODING REMAINS ABOUT THE SAME BEFORE AND AFTER LAND SUBSIDENCE
LAND SURFACE NOW
BENCHMARK
AMOUNT OF SUBSIDENCE
FLOOD WATER SURFACE SUBSIDES ABOUT THE SAME AMOUNT AS THE LAND SURFACE
CURRENT PROPERTY ELEVATION
CURRENT FLOOD ELEVATION
PROPERTY ELEVATION BEFORE SUBSIDENCE
FLOOD ELEVATION BEFORE SUBSIDENCE
SEA LEVEL (NOT AFFECTED BY SUBSIDENCE)

Figure 6 - Land Subsidence Schematic - Riverine Flooding

Although land elevations may change with respect to sea level (NGVD), tidal-surge water-surface elevations of given frequencies will remain unchanged. Thus, continuing land subsidence in t dal areas produces two effects: the depth of the estimated tidal flooding increases; and, the area subject to tidal flooding increases. These effects are illustrated in Figure 7.

The estimated hurricane-surge water-surface elevations associated with this study will not require adjustment, since they are not affected by subsidence. The expected depth of flooding at a property may be obtained by direct comparison of the property elevation with the tidal-surge elevation. Since the land will continue to subside, the FIRM for Harris County may eventually lose its usefulness and require updating. The estimated surge elevations will not change, however, and still may be used to determine flood hazards.

Local officials should be aware of the subsidence problem and should require the use of the most up-to-date and accurate property elevation data in compensating for land subsidence.

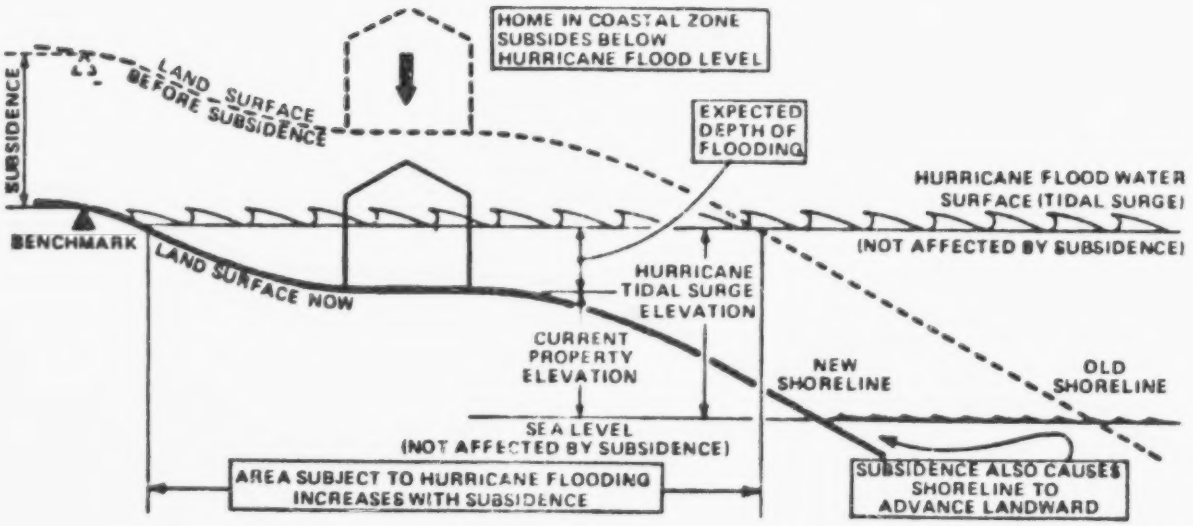

HOME IN COASTAL ZONE SUBSIDES BELOW HURRICANE FLOOD LEVEL
LAND SURFACE BEFORE SUBSIDENCE
SUBSIDENCE
EXPECTED DEPTH OF FLOODING
HURRICANE FLOOD WATER SURFACE (TIDAL SURGE)
(NOT AFFECTED BY SUBSIDENCE)
BENCHMARK
LAND SURFACE NOW
HURRICANE TIDAL SURGE ELEVATION
CURRENT PROPERTY ELEVATION
NEW SHORELINE
OLD SHORELINE
SEA LEVEL (NOT AFFECTED BY SUBSIDENCE)
AREA SUBJECT TO HURRICANE FLOODING INCREASES WITH SUBSIDENCE
SUBSIDENCE ALSO CAUSES SHORELINE TO ADVANCE LANDWARD

Figure 7 - Land Subsidence Schematic - Hurricane - Tidal-Surge Flooding

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the flooding sources studied in detail, the 100- and 500-year floodplain boundaries have been delineated using topographic maps at a scale of 1:24,000 with a contour interval of 5 feet (Reference 3.1.12).

For tidal areas with wave action, the 100-year and 500-year boundaries were delineated using topographic maps at a scale of 1:24,000 with a contour interval of 5 feet (Reference 3.1.12). The

100-year floodplain was divided into whole-foot elevation zones based on the average wave crest elevation in that zone. Where the map scale did not permit these zones to be delineated at one-foot intervals, larger increments were used.

For the flooding sources studied by approximate methods, the 100-year floodplain boundaries were delineated using USGS topographic maps (Reference 3.1.12).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and VE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross

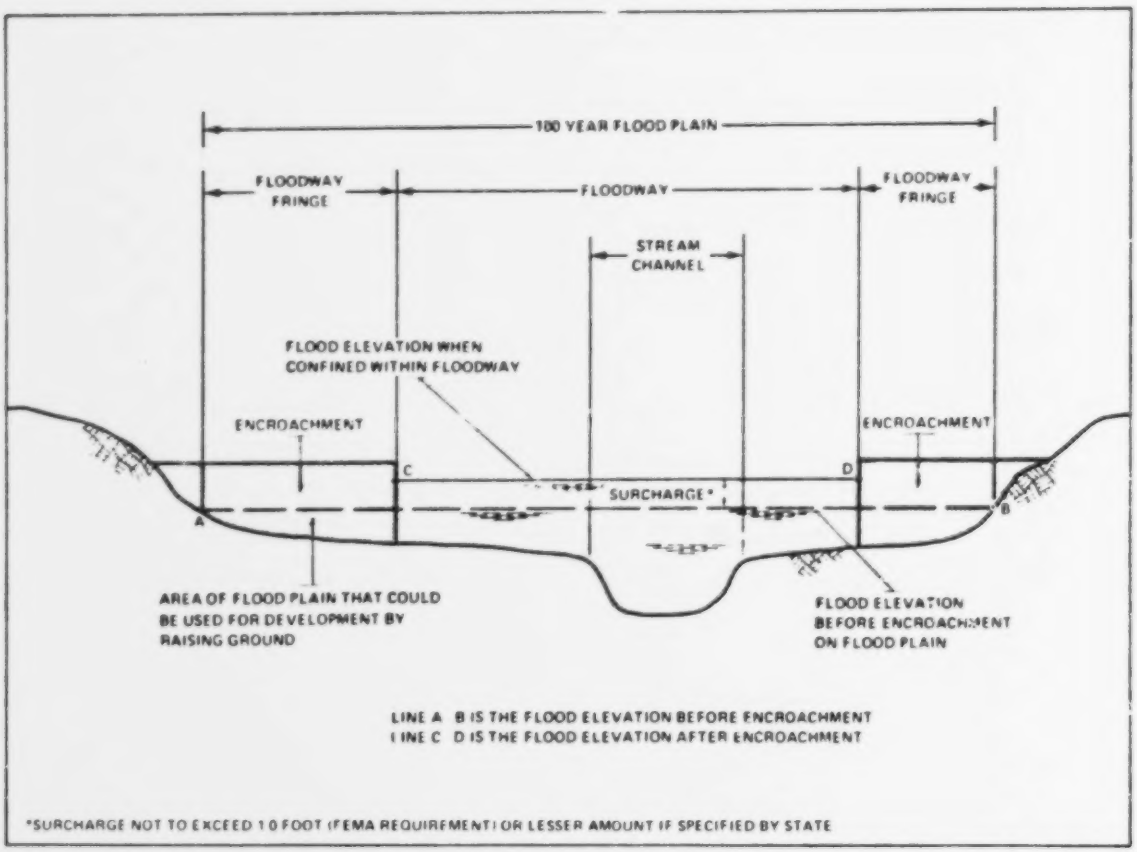
sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 7 - see Volume 2). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway widths for Clear Creek, Cedar Bayou, Mound Creek, Bens Branch, White Oak Creek, the East Fork San Jacinto River, the West Fork San Jacinto River, and Spring Creek extend beyond the county boundary. For certain streams, portions of the floodway widths are contained within the channel banks by a levee system.

Floodways were not delineated for those portions of the streams studied by detailed methods where either of the following conditions are present: the mean velocity in the floodway is less than 1 foot per second for the entire upstream reach; or waves greater than 3 feet in height exist for the 100-year event.

In some cases, a stream has two sets of channel banks. The first and lower set of channel banks is defined where the water surface intersects the ground under normal flow. The second and upper set of channel banks is defined at the points where the ground changes from a relatively steep slope to the more gentle slope of the overbanks. When the floodway width is defined at the upper set of channel banks, an appropriate footnote is included in the floodway data table (Table 7). When this footnote is used, the values for the "Section Area," "Mean Velocity," "With Floodway," and "Increase" columns may be omitted. These values are only included in the table when the information generated by the hydraulic model accurately reflects the defined floodway width at the upper channel banks.

As discussed in Section 3.1, basin overflow is common in Harris County. In basin overflow areas, delineation of floodways is necessary, because uncontrolled development along the basin divide could prevent basin interflow that would increase flood hazards in the downstream area. For this study, the floodway is shown as coincident with the 100-year floodplain boundary in basin overflow areas.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 8.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 8

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 7 for certain downstream cross sections are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources; the streams that are affected by backwater are noted in Table 7. Streams for which regulatory water-surface elevations were computed using a combined probability analysis are also noted in Table 7.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the

contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current Flood Insurance Rate Map (FIRM) presents flooding information for the entire geographic area of Harris County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community are presented in Table 8, "Community Map History."

7.0 OTHER STUDIES

A Flood Insurance Study has been prepared for Brazoria County and Incorporated Areas (Reference 7.0.1). Discrepancies exist between this study and the Brazoria County study along Clear Creek because of adjustments made in the analyses for Brazoria County to account for land subsidence between 1973 and 1979.

Flood Insurance Studies have been prepared for the unincorporated areas of Waller, Liberty, and Chambers Counties (References 7.0.2, 7.0.3, and 7.0.4). Because of the differences in methodologies used, discrepancies exist between this study and those studies.

A Flood Insurance Study is currently being prepared for Fort Bend County and Incorporated Areas; the Flood Insurance Study for the unincorporated areas of Galveston County is currently being revised (References 7.0.5 and 7.0.6). Because of the differences in methodologies used, discrepancies exist between those studies and this study.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
BELLAIRE, CITY OF	June 28, 1974	June 14, 1977	September 30, 1981	May 4, 1987 September 28, 1990
DEER PARK, CITY OF	August 9, 1974	None	August 15, 1980	February 1, 1984 September 28, 1990
EL LAGO, CITY OF	June 2, 1971		June 2, 1971	July 1, 1974 July 11, 1975 December 15, 1983 September 28, 1990
GALENA PARK, CITY OF	February 21, 1975	November 19, 1976	November 2, 1982	September 28, 1990
HARRIS COUNTY, UNINCORPORATED AREAS	May 26, 1970		May 26, 1970	March 10, 1972 July 1, 1974 July 30, 1976 February 24, 1981 March 30, 1982 December 31, 1983 September 27, 1985 February 4, 1988 September 28, 1990

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRIS COUNTY, TX AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
HOUSTON, CITY OF	December 27, 1974	March 10, 1972 July 1, 1987 July 30, 1976 April 8, 1977	December 11, 1979	September 21, 1982 September 27, 1985 September 4, 1987 September 28, 1990
HUMBLE, CITY OF	November 29, 1977	None	September 16, 1982	September 28, 1990
HUNTER'S CREEK VILLAGE, CITY OF	May 10, 1974	December 17, 1976	November 5, 1980	September 28, 1990
JACINTO CITY, CITY OF	June 28, 1974	None	September 2, 1981	September 28, 1990
JERSEY VILLAGE, CITY OF	April 5, 1974	June 27, 1975	March 15, 1982	April 3, 1985 September 28, 1990
LA PORTE, CITY OF	February 17, 1971		February 17, 1971	July 1, 1974 August 22, 1975 November 1, 1985 September 28, 1990
MORGANS POINT, CITY OF	June 28, 1974	September 19, 1975	December 1, 1983	September 28, 1990

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRIS COUNTY, TX AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
NASSAU BAY, CITY OF	November 17, 1970		November 17, 1970	July 1, 1974 September 5, 1975 July 23, 1976 March 15, 1984 September 28, 1990
PASADENA, CITY OF	May 24, 1974		May 24, 1974	July 1, 1974 November 7, 1975 April 23, 1976 June 3, 1986 September 28, 1990
PEARLAND, CITY OF	January 31, 1975	August 13, 1976	July 5, 1984	June 5, 1989 September 28, 1990
PINEY POINT VILLAGE, CITY OF	June 28, 1974	None	December 2, 1980	September 28, 1990
SHOREACRES, CITY OF	November 20, 1970		November 20, 1970	July 1, 1974 September 12, 1975 February 16, 1982 May 15, 1984 September 28, 1990

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRIS COUNTY, TX AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
SOUTH HOUSTON, CITY OF	June 28, 1974	October 17, 1975	March 18, 1987	September 28, 1990
SPRING VALLEY, CITY OF	June 28, 1974	December 3, 1976	June 4, 1980	September 28, 1990
TAYLOR LAKE VILLAGE, CITY OF	November 17, 1970		November 17, 1970	July 1, 1974 September 5, 1975 June 6, 1980 February 15, 1984 September 28, 1990
TOMBALL, CITY OF	January 24, 1975	None	December 18, 1984	September 28, 1990
WEBSTER, CITY OF	May 19, 1972		May 19, 1972	July 1, 1974 June 10, 1977 February 27, 1981 June 15, 1984 September 28, 1990

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRIS COUNTY, TX AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

The Flood Insurance Study for the unincorporated areas of Montgomery County has been revised (Reference 7.0.7). Because the Montgomery County study's analyses for Spring Creek and Bens Branch are more up-to-date, the results of this study are not in agreement with the results of that study.

Flood Insurance Studies have been prepared for the Cities of League City and Mont Belvieu (References 7.0.8 and 7.0.9). Because this study is based on more up-to-date analyses, its results are not in exact agreement with the results of those studies.

Because it is based on more up-to-date analyses, this study supersedes the Flood Insurance Studies for the Cities of Bellaire, Bunker Hill Village, Deer Park, El Lago, Galena Park, Houston, Humble, Hunter's Creek Village, Jacinto City, Jersey Village, La Porte, Morgans Point, Nassau Bay, Pasadena, Pearland, Piney Point Village, Shoreacres, Spring Valley, South Houston, Taylor Lake Village, Tomball, and Webster; and the Flood Insurance Study for the unincorporated areas of Harris County (References 7.0.10, 7.0.11, 7.0.12, 7.0.13, 7.0.14, 7.0.15, 7.0.16, 7.0.17, 7.0.18, 7.0.19, 7.0.20, 7.0.21, 7.0.22, 7.0.23, 7.0.24, 7.0.25, 7.0.26, 7.0.27, 7.0.28, 7.0.29, 7.0.30, 7.0.31 and 7.0.32).

The City of Pearland is located in Brazoria and Harris Counties. Therefore, Flood Insurance Study users should refer to this study and the countywide study for Brazoria County for the complete analysis of flood hazards in Pearland (Reference 7.0.1).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Federal Regional Center, 800 North Loop 288, Denton, Texas 76201-3698.

9.0 BIBLIOGRAPHY AND REFERENCES

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